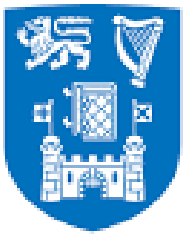

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A Light from Within: Aesthetic Judgments and Emotional Responses to Viewing Religious Stained-Glass Windows

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A dissertation submitted for the degree of Master of Science to the School of Psychology at Trinity College Dublin, the University of Dublin, Ireland. 2024

DECLARATION

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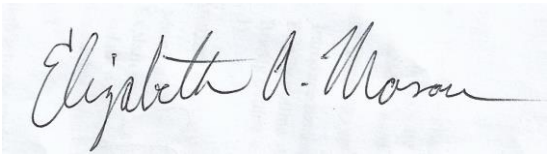

Elizabeth A. Mason

30th September, 2023

SUMMARY

The world around us is full of aesthetic objects which draw our attention and elicit strong emotional responses and preferences, be they in favor of that object or against it. These objects include elements of the natural world as well as those curated artificially, and our perceptions of them derive from a mixture of 'top-down' features – including individual and personality differences (Silvia & Nusbaum, 2011), cultural influences (Darda & Cross, 2022), and prior knowledge about the object being evaluated (Leder et al., 2004) – and 'bottom-down' features, which are derived from the sensory information and specific features of the aesthetic experience. Aesthetic perception is the field of psychology which focuses on how people view, judge, appreciate, and interpret aesthetic objects and scenes in our environment. The discipline considers a wide range of aesthetic objects and scenes as influencing emotional states and forming aesthetic experiences, including landscapes (Smalley & White, 2023), paintings, (Darda & Cross, 2022), and consumer products (Cox & Cox, 2002). However, the aesthetic potential and unique artistic value of stained-glass windows have been, presently, overlooked by researchers in aesthetic psychology. Through their utilization of both artificial and natural elements – i.e. the artistic design of the glass and the necessity of light to illuminate that design – stained-glass windows present several novel considerations for how aesthetic experiences in general are formed and how a combination of aesthetic features can elicit positive emotional responses and promote aesthetic appreciation. With consideration of how current research has mainly only evaluated artificial and natural aesthetic experiences in terms of how they differ from each other, examinations of this artistic medium may provide new insights into how individual differences and sensory information impact our aesthetic experiences.

Chapter 1 begins with an in-depth overview of the relevant literature surrounding models of aesthetic perception, experiences of awe, and stained-glass windows as aesthetic objects. It describes several models of aesthetics which inform the current work, most notably Leder and colleagues' (2004) information processing model and Silvia's (2005) model of aesthetic appraisals. It also identifies several questions for the present research to explore in the investigations following.

Chapter 2 describes a preliminary investigation which was conducted in order to develop an empirical database of stained-glass window images from which to draw from in the following experiments. Because this art medium is so new to the field of aesthetic perception, we endeavored to construct what is, to our knowledge, the first empirical set of stained-glass window stimuli. We drew from the existing literature regarding eliciting factors of awe and aesthetic liking and chose windows based on how large they were perceived to be, how complex they were in colour and quantity of sections, and how familiar they were to the majority of participants. This chapter describes each of these factors in detail as they are recognized in the available literature. From our results, we selected a sample of windows which complied with the specific criteria set for our investigations going forward in this paper.

Chapter 3 presents the first of the two empirical studies with which these stimuli are used. In this investigation, we examined the differences between experts and non-experts in the design and/or history of stained-glass windows in terms of physiological, emotional, and aesthetic responses. Expertise has long been a focus of research in aesthetic perception as an individual feature which impacts how the observer processes, interprets, and appreciates an aesthetic piece (e.g. Leder et al., 2004; Leder & Nadal, 2014). The current understanding of this factor's role in aesthetic appreciation is that experts are privy to more information about the work beyond the content. However, there is

less known about how expertise influences complex emotional experiences such as awe, and how such emotional experiences are depicted using physiological measurements such as pupillometry. This study examines how expertise and visual complexity as a bottom-up factor may influence awe experiences and aesthetic preferences while viewing stained-glass.

Chapter 4 is the second and final empirical study featured in this work. We aimed to examine the effects of different kinds of light variation and intrinsic religiosity on the aesthetic appreciation of religious stained-glass windows. As a key part of their functionality, stained-glass windows are reliant on light in order to capture and convey their aesthetic value as artworks (Allen, 2012). As such, they are considered a unique form of art which not only benefits from natural aesthetic elements, but is dependent on its interaction with the artistic features of the object (i.e., the glass). In aesthetic perception, research has been primarily focused on the differences between natural and artificial aesthetic objects (e.g. Smalley & White, 2023), with less focus on how they interact. Furthermore, notably little research has been conducted investigating the potential of religiosity as a top-down factor of aesthetic judgment, especially as it pertains to religious artworks. This study examined the influence of both factors on how beautiful, pleasurable, attractive, nice, and likeable stained-glass windows were viewed to be (Blijlevens et al., 2017). In doing so, we present one of the first explorations into how a combination of different aesthetic features can create a full aesthetic experience in a unique and kinaesthetic medium.

This thesis concludes with Chapter 5, which gives a general overview of the present work and cites potential paths forward for future experiments. We also address the primary findings and their implications, both as they pertain to aesthetic psychologists and art historians and academics in the field of stained-glass windows.

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CHAPTER 1: GENERAL OVERVIEW

1.1 INTRODUCTION

The field of aesthetic perception is a growing discipline within psychology which considers how aesthetic objects and scenes in our external environments are perceived, appreciated, judged, and responded to. It has garnered increasing interest over the past few decades, particularly as it pertains to investigations into the specific processes and factors which underlie aesthetic experiences and judgments (Leder et al., 2004; Leder & Nadal, 2014). Considerations of how people perceive and appreciate aesthetics in different settings were originally posited by psychologist Gustav Theodor Fechner (1876), who founded the field of experimental aesthetics. He developed the first procedure for empirically evaluating principles of aesthetics and how specific aesthetic features may affect judgment of the overall stimulus (Martin, 1906). Since then, the field has expanded exponentially to apply these principles to all areas of psychology, particularly as they relate to cognition and social dynamics (Jacobsen, 2006).

As empirical work within the field of aesthetic perception continues to grow and modify existing theories of how people appraise and appreciate aesthetic stimuli, it is important to consider the differences in how natural aesthetics versus artificial aesthetics are perceived and appraised. In doing so, we may begin to approach an integrated view of aesthetics which examines areas where natural and artificial aesthetics interact to promote a full aesthetic experience. Such an interaction may be present, for example, in the appraisal of stained-glass windows, which are an as-yet unexplored medium in experimental aesthetics that establish a kinaesthetic interaction between a natural aesthetic feature – natural light variations, such as those observed in sunlight at different times of the day – and an artificial, human-curated artistic medium.

The present review considers a few relevant questions for the field of aesthetics at large. First, what place does a study of aesthetics have

in cognitive psychology? What contributions can be made in studying how people make aesthetic judgments and subsequently appraise the value of an aesthetic object or scene? The cognitive and biological processes underlying these appraisals have been a key topic of focus in recent years (Chatterjee & Vartanian, 2014), and considering how pervasive aesthetic stimuli are in our everyday lives - from consumer products (e.g. Pearce et al., 2017; Veryzer, 1995) and tourist destinations (e.g. Kirillova et al., 2014; Kirillova & Lehto, 2015) to facial features (e.g. Faure et al., 2002; Samuels & Ewy, 1985) and nature aesthetics (e.g. Brady, 1998; Carlson, 1979, 2000; McDonald et al., 2009; Parsons, 2002; Szécsényi, 2021; Smalley & White, 2023; Ulrich, 1983) - the answers to these questions may be consequential to the overall study of sensory perception.

Next, what role do emotions and affective responses play in the formation of these judgments? Much of the literature surrounding aesthetic perception has addressed the importance of emotional responses in mediating relationships between an aesthetic experience and judgment about that experience (e.g. Brown et al., 2011; Marković, 2012; Menninghaus et al., 2019; Palmer et al., 2013; Schindler et al., 2017; Silvia, 2005a, 2005b; Silvia, 2006; Silvia & Brown, 2007; Silvia, 2009; Ulrich, 1983; Vessel et al., 2012). Some studies have even indicated that certain emotions may have a stronger mediating effect than others when examining aesthetics and are more likely to indicate a stronger positive or negative judgment of the value of that experience (e.g. Blijlevens et al., 2017; Fayn et al., 2015; Fayn et al., 2018; Juslin, 2013; Keltner & Haidt, 2003; Menninghaus et al., 2019; Schindler et al., 2017). A further exploration into these specific emotions and how they may influence aesthetic experiences is needed, particularly regarding awe as a complex emotional response.

Further, do different aesthetic mediums evoke different affective responses, and are those responses elicited through different criteria across mediums? The generalisation of aesthetic criteria for eliciting

emotional responses has served as a point of debate for the past several decades, with arguments focusing on whether aesthetic appraisals may be made by focusing on the same features in one aesthetic medium (e.g. nature) as in another (e.g. visual art; Carlson, 2000; Chirico et al., 2021). If it is the case that aesthetic features may be generalised to all areas of aesthetics, how may we best investigate potential comparisons across mediums to determine what those universal features are? If not, under what circumstances can we determine what constitutes an aesthetic stimulus across mediums? How do emotional responses to art differ from those to nature scenes, facial expressions, and so on?

Finally, how can we best approach a convergence of aesthetic features from different mediums when considering a complex aesthetic experience such as stained-glass windows, which are unique in their channelling of a natural aesthetic feature - light - through an artistic lens? Light variation as an aesthetic feature in nature has remained a largely-unexplored topic of investigation within this discipline, though recent studies have begun to highlight its significance in eliciting certain emotional responses, including awe (Smalley & White, 2023). However, these findings have not yet been considered in the context of influencing the viewing of and responses to other aesthetics, and stained-glass windows in particular have yet to be considered for their ability to create aesthetic experiences. The present review will address these questions with the intention of drawing from prior investigations to inform the design of a subsequent empirical study, which will examine how different variations of light may evoke an awe response when viewing stained-glass windows.

1.2 THE PSYCHOLOGY OF AESTHETIC PERCEPTION

When approaching the field of aesthetics as it pertains to how people make judgments and appreciate aesthetic objects and scenes, it must be noted that the term does not only refer to art; it also applies to other objects and scenes within an individual's everyday environment, including consumer products (e.g. Ding et al., 2017), human facial features (e.g. Samuels & Ewy, 1985; Faure et al., 2002), and even scenes in nature (e.g. Carlson, 1979, 2000; Ulrich, 1983). Fechner's (1876) original theory of experimental aesthetics focused on a quantitative, subject-based approach of drawing connections between specific aesthetic, bottom-up factors and preferences of geometric shapes in order to generalise towards overall aesthetics (Lindauer, 1973; Lowie, 1921). While a key benefit to this methodology is the amount of control and systematic organisation of the stimuli, it fails to explore the cognitive and biological underpinnings of these preferences and is extremely restricted in its generalisability across aesthetic mediums, particularly non-artistic or non-visual experiences (Lindauer, 1973).

Fechner's approach to studying aesthetics dominated the discipline for nearly a century after its initial proposal as investigators of aesthetic preferences sought to isolate specific features based on laboratory and field work findings (e.g. Eysenck, 1968; Lowie, 1921; Martin, 1909; McManus, 1980). Approaches to 'new modern aesthetics', however, began to emerge in the 1960s and 1970s in response to the need to attribute cognitive and biological processes to the ways in which people make aesthetic judgments (Berlyne, 1970, 1971, 1974; Lindauer, 1973; Silvia, 2005b). Daniel Berlyne (1974) attributed the chief mechanism of these processes to psychobiological systems of arousal and reward when appreciating aesthetic experiences. Building on his original theory of curiosity, Berlyne describes a set of 'collative variables' of aesthetics that contribute to emotional responses; these

include complexity, novelty, uncertainty, and conflict, and each utilises an arousal potential which is either based in reward or aversion systems (Berlyne, 1960, 1974; Silvia, 2005b).

There exists some neural evidence to support the activation of these systems during aesthetic judgment. During a neuroimaging study utilising functional MRI, for example, Kawabata and Zeki (2004) found that, when viewing different paintings categorised by participants as 'beautiful', 'ugly', or 'neutral', the judgment of whether a painting was beautiful or not was associated with increased activity in the orbito-frontal cortex, a significant area for processing rewarding stimuli. However, the researchers also found that the category of the painting - abstract, still life, portrait, and landscape - were associated with distinct visual areas of the brain during perception, indicating that specific features unique to each of these categories may influence aesthetic assessment either alongside or overruling reward systems. These findings, taken together with failed attempts to empirically test which stimuli would elicit the strongest arousal and therefore be judged as the most 'pleasing' (e.g. Martindale et al., 1990), illustrated one major flaw in Berlyne's model: it lacks clarity in explaining how arousal and reward systems work together with perception in order to facilitate affective responses to stimuli (Skov, 2019).

Furthermore, as Silvia (2005b) addresses, the structure of Berlyne's theory did not originally allow room for explanations of affective processes beyond general arousal and shifts between that reward and aversion. As the focus has shifted in studying aesthetic preferences from explanations of arousal to the role of emotions, the terms described in Berlyne's framework of arousal (preference, reward value, hedonic response, affective response, etc.) are now considered to be too ambiguous to fully describe the processes underlying affective responses to aesthetics (Leder et al., 2004; Silvia, 2005b). It should be noted, however, that while Berlyne's ideas of general arousal and reward systems have been dismissed for their ambiguity and lack of supportive

evidence for affective processes, the aforementioned 'collative variables' are still highly regarded and considered within the literature surrounding aesthetics as contributing factors to aesthetic experience (Althuizen, 2021; Silvia, 2005a, 2005b).

Modern studies of aesthetics tend to utilise one of two perspectives when examining how people formulate judgments about aesthetic stimuli. The first of these is an information processing model, originally proposed by Leder, Belke, Oeberst, and Augustin (2004). Their framework describes an information-processing stage model of specifically visual aesthetic perception which divides aesthetic experience into five distinct states - perception, explicit classification, implicit classification, cognitive mastering, and evaluation - with aesthetic emotion and aesthetic judgments representing two different kinds of output. Key to note here is the separate nature of the two outputs described: while both tend to take into account an individual viewer's liking and preference, 'aesthetic emotion' depends entirely on the affective processing and subjective cognitive appraisal of the stimulus while 'aesthetic judgment' often relies more on a cognitive assessment of the stimulus' value. The two may influence each other if the elements which inform the cognitive appraisal are also perceived to add to its value - i.e. a positive appraisal may be indicative of a positive judgment - but the processes underlying their development appear to be independent of each other.

The key focus of Leder and colleagues' (2004) model is the interaction between cognitive and affective processes which underlie aesthetic experiences and judgements. This interaction can be applied across modalities and aesthetic categories (Brown et al., 2011). For example, consider the case of symmetry in facial features: studies of aesthetic preferences in relation to symmetry in faces have supported symmetry as an influential factor of aesthetic perception (Peck & Peck, 1970; Rhodes et al., 1998). However, utilising top-down processing within Leder and colleagues' (2004) model to account for individual

differences such as art expertise minimised the effect symmetry had on overall ratings of beauty in facial features (Monteiro et al., 2022). This not only provides support for the model's incorporation of cognitive processing based on contextual appraisals - it also highlights the influence of individual differences and top-down factors in forming judgments, particularly in the case of expertise wherein affective influences are mediated by pre-existing knowledge.

The second perspective to be considered is a cognitive appraisal approach to aesthetic experiences (Silvia, 2005a, 2005b). This approach distinguishes between different emotional responses to aesthetic stimuli and the biological functions and appraisal structures which define them (Lazarus, 1991). This focus considers how affective responses are broken down into certain appraisal components, which are unique depending on the emotion experienced and contribute to the final judgment of the experience (Lazarus, 1991). Empirical research has been conducted in this area highlighting the potential of appraisal theory in defining the parameters of aesthetic experience. Evidence disproving this model and providing support for an appraisal approach has shown that while complexity does appear to possess a relationship with aesthetic liking and behavioural intentions surrounding that liking, this relationship is far more complex than Berlyne describes and is mediated by specific, bottom-up characteristics of the stimulus (e.g. Althuizen, 2021), individual differences (Ladinig & Schellenberg, 2012; Silvia & Nusbaum, 2011), and emotional states (e.g. Leder et al., 2013; Menninghaus et al., 2019; but see Chassey et al., 2015 for evidence supporting the inverted-U model). Neuroimaging studies have provided further evidence of the complexity of aesthetic appreciation and judgment and have illustrated the role of appraisals during these processes (e.g. Ferrari et al., 2015; Vartanian & Skov, 2014).

Modern theories of emotional cognition in aesthetics have favoured appraisal theories of emotion, which not only expand aesthetic experiences beyond positive affects to incorporate negative and even

neutral responses to art and aesthetics, but also consider how individual differences and experiences may inform preferences and judgements (Silvia, 2005a, 2005b). When considering appraisals of stained-glass windows such as the present study seeks to investigate, it is important to keep such findings in mind as a central feature of many stained-glass windows - particularly those with religious themes - are images of faces and figures. Attentional studies focusing on figures in images have noted that participants' gaze patterns are more likely to direct their gaze towards the figures and their facial features first before examining the rest of the image (de Winter et al., 2022; Yarbus, 1967). How viewers appraise the images within the windows may be just as important as appraisals of the windows themselves in forming aesthetic judgments, and the current design will take this evidence into account as points of interest.

From these considerations of the various approaches which have been made towards addressing aesthetic perception, we can determine based on empirical evidence that models of appraisal such as the framework proposed by Leder and colleagues (2004) present the more integrated conceptualisation of the processes underlying aesthetic judgments to date. As we move toward our primary objective of investigating the potential impact of variations of light within stained-glass windows on specific emotional responses, it is imperative to next discuss what specific emotional responses are often evaluated in the realm of aesthetics, including the complex experience that we will seek to investigate in the present methodology: awe.

1.3 AESTHETIC EMOTIONS AND AWE IN AESTHETICS

As stated previously, the ways in which we make judgments about aesthetics rely substantially on our emotions, both in terms of how we may feel when initially encountering the aesthetic experience and how the experience itself influences our emotional states. These emotional responses specifically develop in response to aesthetic experiences and are known in the literature as 'aesthetic emotions'. Initially described in the work of Immanuel Kant (1790/2001), these specific responses always contain an aesthetic evaluation or appreciation of the stimulus or stimuli in question, placing the focus on the aesthetic elicitors of the emotion rather than the emotional response itself.

One conceptual, multicomponent framework describing the way aesthetic emotions are formed and contribute to the aesthetic appraisal process was developed by Menninghaus and colleagues (2019). According to the framework, aesthetic emotions are distinct in that they always include an aesthetic evaluation of the stimulus and are differentiated by their contributions to a specific aesthetic virtue or appeal. The aesthetic experience is subjectively appreciated for its own sake and value, and aesthetic emotions serve a function of shaping those preferences to be referred to in future experiences. The framework is especially useful in that, in addition to cognitive appraisals based on subjective interpretations and emotions, Menninghaus and colleagues (2019) consider the physiological and expressive aspects of aesthetic experience alongside the ways in which individual differences and other top-down factors may influence preference.

Despite their early origins (Kant, 1790/2001), investigations into the scope of aesthetic emotions have only recently begun to gain interest in the field of aesthetics, and thus empirical data supporting Menninghaus and colleagues' (2019) model are still being explored. There are a few investigations which were published prior to the development of this model, however, which may assist in shedding light on the topic of aesthetic emotions: for example, one investigation into

the effects of aesthetic emotions in visual art appreciation studied how the processing fluency of an image - i.e. the cognitive ease with which sensory information is processed (Reber et al., 2004) - related to aesthetic preference (Kuchinke et al., 2009). Of note in this study was the utilisation of pupillary data, which, in congruence with the positive relationship between processing fluency and preference, reflected increases in pupil dilations following participants' points of explicit classification of a recognisable object within a given image. Along with these findings, physiological correlates of aesthetic emotions as depicted in the literature include chills or goosebumps, tears, and signs of high activation levels in the sympathetic nervous system such as increased heart rate (Wassiliwizky, Jacobsen et al., 2017; Wassiliwizky, Koelsch et al., 2017).

In line with these challenges in the experimental literature surrounding aesthetic emotions, there are few standardised measures of aesthetic emotions which both involve an assessment of the aesthetic value of a stimulus and discern between aesthetic virtues which each emotional experience functions to predict (Menninghaus et al., 2019). Schindler and colleagues (2017) addressed this gap in the literature by designing an assessment tool comprised of 21 subscales in order to assess the intensity and nature of emotional responses to a stimulus' perceived aesthetic value in a manner which differentiates between responses to different aesthetic mediums and characteristics. In doing so, the Aesthetic Emotions Scale (AESTHEMOS) focuses on several different categories of emotions, including prototypical aesthetic emotions (such as the feeling of beauty or being moved), positive or amusement-indicative emotions (such as humour or happiness), and epistemic emotions (such as interest or insight).

The latter of these emotional categories requires further exploration. Epistemic emotions, which develop as a result of information-oriented appraisals, concern the level of congruency or incongruency between new information and existing mental schemas or

beliefs (Muis et al., 2018). Whereas positive epistemic emotions may arise when new information verifies or is consistent with individuals' prior beliefs, negative epistemic emotions may occur in response to information that challenges or contradicts those beliefs (Muis et al., 2015). Importantly, this category - which includes feelings of curiosity, frustration, and anxiety surrounding the assimilation of new information - contains one particular emotional experience which has been a subject of affective responses for a number of years in the field of aesthetics, and which has not yet been examined in the context of integrative aesthetic experiences such as stained-glass windows: that being the complex emotional experience of awe.

1.4 THE AWE EXPERIENCE

In psychology, awe is defined as an emotional process which forms as a result of two central appraisals: a perception of a vast or cognitively overwhelming stimulus that cannot be assimilated and a need for accommodation of existing mental schema in response to that stimulus (Keltner & Haidt, 2003). While other conceptualisations of awe in psychology have been posited since this initial definition (e.g. Halstead & Halstead, 2004; Schneider, 2017) and despite an acknowledgment of potential limitations in this definition pertaining to conducting non-quantitative studies of awe (Schneider, 2017), this characterisation of the term is the most widely accepted and applied definition in psychology, particularly with regard to quantitative-experimental studies of awe (e.g. Gill et al., 2022; Van Cappellen & Saroglou, 2012).

In order to fully understand this conceptualisation of awe experiences, it is important to consider how the two aforementioned appraisals - a perceptually-vast or overwhelming stimulus and a need to accommodate that stimulus - are defined and applied in relation to awe and specific awe elicitors. Keltner and Haidt (2003) define 'vastness' as anything that is experienced as larger than the self, or the self's ordinary level of experience or frame of reference' (p. 303). Note while 'vastness' may refer to a stimulus' physical size - such as in the case of a viewing broad landscape or large monument (Gill et al., 2022; Keltner & Haidt, 2003; Pearce et al., 2017) - it can also refer to what is known as 'conceptual vastness', which may not be large in scale but still implies a sense of power, skill, or existentiality that cannot be assimilated into pre-existing mental schemas and therefore overwhelms the perceiver of the stimulus (Keltner & Haidt, 2003; Rauhoeft et al., 2015; Richesin & Baldwin, 2023; Yaden et al., 2019).

Regarding the second appraisal necessary for evoking awe, the need for accommodation of existing mental schema refers to the process of attempting (whether successful or not) to adjust existing mental schemas that cannot assimilate a new experience (Keltner & Haidt,

2003). It is this aspect of awe which characterises its function as an epistemic emotion, which is a categorisation of emotional experiences that facilitate or play a key role in the cognitive processes surrounding learning and understanding (Valdesolo et al., 2017). Prior investigations of awe's categorisation posit the role of pre-existing schema and expectations in determining whether awe influenced behavioural intentions and explanation-seeking in situations of uncertainty, such as when participants were asked to choose between scientific or religious explanations for evolutionary evidence (Valdesolo et al., 2016).

Some debate has surrounded the limitations of this particular appraisal: for example, in his review of experimental awe in psychology, Schneider (2017) suggests that Keltner and Haidt's (2003) characterisation of this need for accommodation is too confined for examining awe through a humanistic-qualitative design because awe – as defined in the Miriam-Webster dictionary (1988) - is conceptualised not only by a lack of assimilation, but a lack of accommodation as well. In consideration of this argument, recent studies of awe have begun to highlight how truly complex the nature of this experience is: multiple recent studies of awe have highlighted the complex contributions to and results arising from awe experiences (e.g. Gallagher et al., 2014; Gallagher et al., 2015; Reinerman-Jones et al., 2013). This includes the impact of top-down factors such as individual differences (e.g. Chen & Mongrain, 2021; Gallagher et al., 2015; Pilgrim et al., 2017; Reinerman-Jones et al., 2013), cultural influences (e.g. Bai et al., 2017; Sawada & Nomura., 2020), and religious or spiritual standing (e.g. Van Cappellen & Saroglou, 2012; Gallagher et al., 2015; Valdesolo et al., 2016; Valdesolo et al., 2017). Awe's valence is heavily debated (Chirico & Gagglioli, 2018), and more recent developments have even posited that different characteristics of awe exist which may induce either a positive-based or threat-based experience of awe (Gordon et al., 2017; Sawada & Nomura, 2020).

It would appear, therefore, that the concept of awe appears to be more complex and multifaceted than Keltner and Haidt (2003) originally described. While the bases for their definition still remain as important contributions to studying awe-eliciting stimuli in future research, we must also seek to build upon and expand this definition in order to incapsulate the full breadth of the awe experience, particularly with regard to aesthetics and specific aesthetic features which may evoke complex awe experiences.

1.4.1 Elicitors and Factors of Awe

As the overview in Table 1-1 illustrates, specific features of aesthetic experiences have been found to elicit awe and mediate judgments of aesthetic value. These features include both those tied directly to aspects of the aesthetic itself and individualised factors which mediate the perception and judgment of that experience (Chirico & Yaden, 2018; Graziosi & Yaden, 2019; Shiota et al., 2007; Yaden et al., 2019). The manner in which actual aspects of the experience interact with the individual's subjective perception and appraisal of the aesthetic's value is complex and requires further exploration as current studies investigating these relationships reflect multifaceted interactions between variables to influence not only the intensity, but the valence, of awe (e.g. Briñol et al., 2018; Gallagher et al., 2015). This has been illustrated through data from one eye-tracking study, wherein participants viewing positive awe elicitors and negative awe elicitors in a museum focused on different exhibit features depending on whether that exhibit was more likely to induce positively-valanced or negatively-valanced awe (Krogh-Jespersen et al., 2020). Results of this study suggested that the position of certain features (such as the overhead placement of the dome in the positively-valanced section) and the lighting of a space (such as the darker scene present in the negatively-valanced section) elicited different facets of awe, such as feelings of connectedness and a diminished sense of self in the case of positive awe

or feelings of disconnectedness and greater levels of oppression in the case of negative awe.

Eliciting Factor	Definition	Supporting Research
Novelty	The experience of something new or different from ordinary everyday (Mitas & Bastiaansen, 2018).	Chen & Mongrain (2021), Chirico & Yaden (2018), Fayne et al. (2015), Shiota et al. (2007)
Information-Rich/Presence of Context	Either context behind an experience or a large quantity of information contained within an experience.	Shiota et al. (2007), Shiota et al. (2017)
Scale	Either physical size possessing large, powerful, or overwhelming conceptual or physical implications (Keltner & Haidt, 2003).	Luke (2021), Quesnel & Riecke (2018), Zhang & Keltner (2016)
Visual Complexity	Elements of a stimulus related to the quantity and variety of information displayed (Van Geert & Wagemans, 2020).	Arcangeli et al. (2020), Armstrong et al. (2008), Pilgrim et al. (2017)
Perceived Skill from Creator(s)	In the case of art and artificial aesthetics, the perceived skill and talent of the individual(s) curating the experience.	Hu & Meng (2022), Luke (2021)

Table 1-1: Known awe-eliciting factors in psychology with supporting research included.

Evidence from brain activity data collected during reported awe experiences also sheds some light on the aesthetic and individual

elements which are more likely to elicit awe. For example, Gallagher and colleagues (2015) conducted an integrated, 'phenomenological' (i.e. experiential) investigation of awe experiences after viewing images of space from the perspective of an astronaut in which they conducted electroencephalography (EEG) tests in order to provide physiological correlates of awe and wonder experiences as reported in participant interviews. According to their data, participants who reported experiencing awe during the simulation also experienced increases in alpha wave levels (associated with states of wakefulness) and beta wave levels (associated with states of alertness and attentiveness) during viewing of simulated space images in comparison to non-awe experiencers whereas non-awe experiencers experienced increases in theta wave levels (associated with states of sleepiness and inattentiveness) that correlated with their reported senses of boredom and lack of focus (Gallagher et al., 2015). These findings suggest an attempt to integrate the context of the awe elicitor with what is being perceived, or potentially a shift in attention as the visual stimulus shifted and changed. Other studies have demonstrated more visible physiological responses to awe experiences, such as chills (e.g. Algoe & Haidt, 2009; Pilgrim et al., 2017; Silvia et al., 2015).

One of the most well-researched and yet least-understood contributing factors to awe experiences is the individualised experience of religion and spirituality (Kearns & Tyler, 2020; Preston & Shin, 2017; Saroglou et al., 2008). While Keltner and Haidt (2003) posit that religiosity and spirituality are not necessary in order to experience awe, a great deal of research has been dedicated to assessing the extent to which the two interact. For example, one of the first investigations into this relationship examined how awe experiences influence behavioural intentions when mediated by religious versus hedonistic or secular stimuli (Van Cappellen & Saroglou, 2011). By asking participants to recall an occasion when a natural setting elicited awe, the researchers were able to show the moderating effect of awe in the relationship

between religiosity and spirituality and the endorsement of the idea to travel to a spiritual destination, particularly in comparison to another positive emotion - pride - which did not moderate this relationship. These findings are significant in considerations of how awe, as a 'self-transcendent' emotion (Chirico & Yaden, 2018; Keltner & Haidt, 2003; Shiota et al., 2007; Yaden et al., 2016) may play a role in building prosocial relations within religious groups.

While investigations such as Van Cappellen & Saroglou's (2011) may illustrate a positive association between awe and religion and spirituality (see also Kearns & Tyler, 2020), other findings have called into question the directness of this relationship (e.g. Gallagher et al., 2015; Gottlieb et al., 2018; Keltner & Haidt, 2003; Reinerman-Jones et al., 2013). For example, in their investigation into awe and wonder experiences in the context of simulated outer space experiences, Gallagher and colleagues (2015) reported an adverse effect of religion and spirituality on whether participants reported having experienced awe during post-trial interviews. Of note, however, was that these results were not consistent across all simulated conditions: while participants who experienced awe when viewing a simulated image of earth also reported engaging in less private religious and spiritual practices, those who experienced awe when viewing a simulated image of deep space actually reported higher engagement in religious and spiritual practices than those who did not experience awe during that condition. These results indicate that the connection is not so straightforward as might be initially expected, and further research into what variables may moderate this relationship - be it from the origin of the aesthetic stimulus or from the standpoint of personality differences - is necessary.

Despite the emphasis on obtaining quantitative data from awe experiences (Schneider, 2017), it is only recently that a standardised self-report measure for awe has been developed and validated which presents a robust account for the different factors that comprise an awe

experience (Yaden et al., 2019). Known as the Awe Experience Scale (AWE-S), the six-factor measure contains 30 items assessing awe experiences on a seven-point Likert scale. The items include questions regarding physiological responses (e.g. 'I gasped' or 'I had goosebumps'), perceived vastness (e.g. 'I experienced something greater than myself'), a need for accommodation (e.g. 'I felt challenged to understand the experience'), time perception (e.g. 'I noticed time slowing'), self-diminishedness (e.g. 'I felt my sense of self shrink'), and connectedness (e.g. 'I felt closely connected to humanity'; Yaden et al., 2019). Based on this differentiation between each factor of awe, the design of the AWE-S would be a beneficial tool to consider for present and future research, particularly in studying aesthetic experiences and the specific elements which evoke awe experiences.

As mentioned previously, the function of awe as a response to aesthetic stimuli has been extensively studied in recent years in a number of contexts. Empirical evidence suggests that awe experiences tend to differ in their intensity, valence, and eliciting characteristics between aesthetic categories, such as when comparing how people experience awe in response to aesthetics in art versus in nature (Chirico et al., 2021). As Carlson (2000) asserts, the composition of a natural scene and the elements which contribute to its aesthetic appreciation are wholly different from the aesthetic components of visual art. For example, whereas considerations of the order and design of a painting may add to the aesthetic value based on the skill of the painter, nature is typically considered not to possess an intentional design and is sometimes depicted as disordered or even chaotic (Kotabe et al., 2017). In addition, the perception of a 2D or even 3D visual artwork is often not considered as immersive as experiences within nature (Konečni, 2015). As a result, affective responses to and appraisals of both are also found to be characteristically different (Chirico et al., 2021). In the context of awe, we will examine these differences more closely in order to discern the points at which they may overlap, such that these

distinctions may further inform the present investigation's insight into a study of awe as an affective response to viewing a combination of natural and artificial aesthetics, as is the case with the perception of stained-glass windows.

Modern research into the awe-eliciting factors of natural and artificial aesthetics have begun to explore how specific features of both interact with mediating factors such as individual and cultural differences to aid in the process of evoking awe experiences (Quesnel et al., 2018). One key tool in pursuing the answers to these questions has been the use of virtual reality (VR) equipment to simulate awe-eliciting experiences (e.g. Chirico et al., 2021; Gallagher et al., 2015; Quesnel et al., 2018). For example, one recent investigation compared VR experiences of the sublime - an affective concept closely linked to the experience of awe, and often used almost interchangeably within the literature on aesthetics (e.g. Arcangeli et al., 2020; Clewis, 2021; Gordon et al., 2017; Konečni, 2005) - between an immersive experience of Vincent Van Gogh's The Starry Night painting and a photorealistic depiction of Saint-Rémy-de-Provence, the actual location depicted in the painting (Chirico et al., 2021). Their findings suggest that not only are natural aesthetics more likely to induce more intense affective responses, but the features which elicit emotional responses in both appear to differ. For instance, while the photorealistic experience created more feelings of being present in the scene than the artistic experience, it also elicited stronger feelings of fear and was overall perceived as being vaster than the alternative.

As one of the first empirical studies to compare natural and artificial aesthetic experiences for their ability to evoke affective responses, these findings are important to consider as we pursue an investigation of the aesthetic potential of stained-glass windows, which, as previously mentioned, are unique in their combination of both kinds of experiences. It is also important to recognise that awe-eliciting elements of aesthetics in nature have primarily been considered under

the context of static, unchanging landscapes and other natural scenes. Very few studies have considered the aesthetic value of more dynamic elements in nature which may elicit awe, such as wildlife (e.g. Hicks & Stewart, 2020) and - most notably for our current purposes - variations of light.

1.5 LIGHT IN AESTHETICS, AWE, AND STAINED-GLASS WINDOWS

As previously mentioned, awe may be elicited by different elements within aesthetic stimuli depending on what aesthetic category that stimulus belongs to (e.g. Chirico et al., 2021). In the context of nature-based aesthetics, much of the empirical research has been conducted on the awe-eliciting features of various landscapes (e.g. Shiota et al., 2007). However, recent studies investigating perception and affective experiences in nature have begun to take more dynamic elements into account by considering how changes in weather patterns, seasonal shifts, the presence and quality of certain plant life, the change of sunlight throughout the day, and other 'ephemeral phenomena' may alter the aesthetic experience in both urban and rural environments, more so than control 'blue sky' settings (Brassley, 1998; Smalley & White, 2023). These phenomena include sunrises and sunsets (Smalley & White, 2023), rainbows (Gedzelman & Vollmer, 2008; Smalley & White, 2023), parahelia or halos (Gedzelman & Vollmer, 2008), and even the image of a starry night sky (Rolston, 2011; Szécsényi, 2021). This third example has been a point of particular interest in the literature surrounding natural aesthetics, particularly as it pertains to feelings of awe, wonder, and a connectedness (or lack thereof) to the rest of the universe (Rolston, 2011).

While light variation as an element of visual art forms has not been extensively explored in relation to affective responses - particularly awe - some evidence arises from accounts of architectural design (Ramos, 2015). In architecture, contrasts between light and shadow are often utilised in order to pursue an expression of extremes in structural design; as Michel (1995) argues, the way in which a space is illuminated is an integral part of the sensory experience of the designed area. These observations are partially explored in studies of urban landscapes and design, wherein the potential effects of natural and artificial light

variations are taken into account for how they will impact the affectual response to the architectural structure (e.g. Smalley & White, 2023).

In the design of religious or sacred architecture, light plays a significant part in creating a sense of space and spirituality within a place of worship, such as is found in places like La Sagrada Familia in Spain (Monzavi & Günçe, 2019). Here, the light cast from outside through the colourful stained-glass windows which adorn the interior is intended to create a suitable atmosphere for religious prayer and meditation (Monzavi & Günçe, 2019). In religious and spiritual spaces more so than others, perhaps, it can be argued that the role of light is especially important as it can often represent symbolic or thematic elements of the religious space while also contributing to the colour and contrasts of the place itself (Monzavi & Günçe, 2019; Wu, 2019).

Considering this symbolic role of designing a structure around light, one seemingly obvious avenue for aesthetic research to pursue in relation to both natural and artistic aesthetic elements is the appreciation and perception of stained-glass windows, which are structured and designed for the specific purpose of interacting with light; yet, to date, no empirical studies in the realm of aesthetic perception and appreciation have been conducted examining this medium, particularly in relation to awe experiences.

Historically, stained-glass windows have possessed great architectural, symbolic, and cultural significance, particularly during the Middle Ages in Europe (Raguin, 2013). During this time, stained-glass windows were especially designed in order to interact with and filter external light into a space, and the context within which they are placed often determines the design and extent of lighting utilised (Raguin, 2013). From a symbolic and design standpoint, the content and artistry of stained-glass windows were purposefully intricately bound up with Biblical themes of light and divinity (Brown & O'Connor, 1991; Marks, 1993; Raguin, 2013; Ramos, 2015; Roswell, 2016). Abbot Suger (1144-1145/1979), a 12th century statesman known for his architectural

contributions to the emerging Gothic movement, describes not only his affinity for creating an aesthetic to promote meditation and self-reflection through decorative usage of gemstones and precious metals, but also the significance of transmitting light into the space in order to illustrate the presence of the Divine, 'transferring that which is material to that which is immaterial' (Suger, 1144-1145/1979, p.65). Transmitted light functioned as a representation of the Biblical descriptions of Christ as the Light of the world (Brown & O'Connor, 1991), and Rosewell (2016) describes how St. Bernard of Clairvaux associated the streaming of light through glass and the purity of the Immaculate Conception of the Virgin Mary. Whereas earlier designs for windows in grand cathedrals emphasised a sense of splendour and grandiose symbolism through their mixed design of denser and translucent patterns, smaller parishes often utilised smaller, simpler, and more sympathetic designs in order to facilitate emotional connections between parishioners and God (Raguin, 2013). Even in non-religious contexts - such as in the craftmanship of heraldic windows for a display of familial legacy and prestige - the contrasts of colour and transmission of light were important for their function of creating a dramatic display (Raguin, 2013).

Given that the symbolic and functional elements of stained-glass windows rely on light in order to communicate a certain message and given that light as an aesthetic factor is so central to the overall experience of viewing stained-glass windows, it comes as a surprise that such a gap in the literature exists as the one that has been previously noted.

1.6 THE PRESENT STUDY

With these considerations from the available literature in mind, the present study will aim to examine how light variation as a kind of aesthetic feature may elicit an awe response in the viewer of stained-glass windows. Keltner and Haidt (2004) assert that, among other factors, contrasts in light and shadow are capable of eliciting awe; though thus far, however, no empirical investigation has been conducted in the field of psychological aesthetics to confirm this association. Based on prior investigations into the affective impact of differences in light patterns in both artistic (e.g. Schielke, 2020) and natural settings (e.g. Smalley & White, 2023), it can be hypothesized that light variation will influence self-reported levels of awe and other aesthetic emotions following the depiction of a manipulated stained-glass window image.

Furthermore, this study will also seek to examine the mediating effects of specific characteristics in the observers of the stimuli which may ~~add~~ impact their aesthetic experience; in this case, we will be considering individual participants' self-reported religious affiliations and knowledge of either the history or the craftmanship of stained-glass windows. It has already been reported in the literature that while religiosity is not a prerequisite for an awe experience – and occasionally may actually hinder one's ability to experience awe (see Gallagher et al., 2015) – the influence of an individual's religious beliefs does have an impact on behavioural patterns following awe experiences, particularly in comparison to non-religious participants (Van Cappellen & Saroglou, 2012). This demonstrates the potential variability of the present study's stimuli focus, particularly as the medium in question – stained-glass windows – has historically been considered in mainly-religious contexts. However, very little research has been conducted on the influence of religiosity in the field of aesthetics, particularly in regard to whether the aesthetics are perceived differently by individuals of differing religious affiliations, and whether any differences are mediated by specific visual features, such as light variation.

Finally, regarding the previously mentioned considerations of expertise, the current study will explore the mediating influence of prior knowledge in either the history or the creation of stained-glass windows as it relates to the relationship between light variation and the awe experience. While novelty is recognised as a common elicitor of awe (Shiota et al., 2007), so too is an information-rich context and appreciation for an artist's skill, two factors which may be enhanced through prior knowledge of the artistic medium in question. Therefore, while familiarity with the stimuli may limit the awe experience in experts of stained-glass windows, the addition of contextual information and a knowledge of the skill required to produce each window may actually elicit a stronger sense of awe in experts than in participants with no or little prior knowledge of stained-glass windows.

The following investigation hopes to shed some light not only on how stained-glass windows can be effectively incorporated into the psychological discipline of aesthetics, but also to explore the influence of specific visual features – in this case, light and shadow contrasts – on affective responses, as mediated by individuals' specific personality traits, subjective experiences, and prior relevant knowledge.

CHAPTER 2: ASSEMBLING A STIMULUS DATABASE OF IMAGES OF RELIGIOUS STAINED-GLASS WINDOWS

2.1 INTRODUCTION

2.1.1 Aesthetic and Awe-Eliciting Features of Art

When investigating the potential for stained-glass windows to be used in studies of aesthetic evaluation and emotional responses, it is imperative to consider those features of artworks and artificial aesthetics which are most aesthetically appreciated and most successful in eliciting awe experiences. The purpose of the present review is to outline those features by order of importance as they were considered in the assembly of a comprehensive, practical stimulus database, the methodology for which is considered in Section 2.2. In considering the roles of specific artistic characteristics as they relate to the aesthetic evaluation of other visual artworks, we aim to develop a hypothesis regarding how these specific features may influence viewers' judgments and responses to stained-glass windows. In doing so, we can progress toward establishing a means of controlling for these factors on an investigation-specific basis according to the aims, questions, and methodology included.

Notably, in addition to art-specific features, the unique and kinesthetic nature of the medium of stained glass reflects an essential relationship with light and its variation; however, for the purpose of compiling the current database, the present focus remains on those characteristics which are related to the artistic design only of the specific windows. The question of light and its role in the aesthetic evaluation of stained-glass windows is explored later in this thesis (see Chapter 4). For now, we consider the more general aesthetic features of visual art which are known to influence aesthetic liking and elicit awe as they may apply to stained-glass windows. These aesthetic features are visual complexity, perceived scale, and overall familiarity of the artwork.

2.1.1.1 Visual Complexity

Visual complexity as an aesthetic feature has long been a focus of investigation as it pertains to aesthetic judgments of, and emotional responses to, artworks. Here, the term visual complexity refers to the amount or intricacy of details in an image (Snodgrass & Vanderwart, 1980). In the case of visual objects and images, this includes the variety of colour (Kocaoğlu & Olguntürk, 2018), the number of different objects or sections (Rosenholtz, Li, & Nakano, 2007), the thematic construction of the subject matter depicted (Snodgrass & Vanderwart, 1980), or the separation and organization of figures or objects in an image (Rosenholtz et al., 2007). Research exploring the role of visual complexity in aesthetic processing and judgment has been extensive and varied (e.g. Berlyne, Ogilvie, & Parham, 1968; Berlyne, 1970; Commare, Rosenberg, & Leder, 2018; Gartus & Leder, 2013, 2017; Kocaoğlu & Olguntürk, 2018; Snodgrass & Vanderwart, 1980), yet the nuance of their relationship is not understood fully.

One of the most well-known theories of the role of visual complexity in aesthetic perception was proposed by Daniel E. Berlyne (1968, 1970, 1971, 1974). In his model, Berlyne (1971) describes what is often referred to as an 'inverted-U' relationship between aesthetic appreciation and complexity, which suggests that artistic images with moderate complexity are aesthetically preferred and more interesting than images which are either too simple or too complex. This is based on the influence of two conflicting cognitive effects: the negative effect of expending cognitive effort during stimulus processing, and the positive effect of cognitive arousal or interest in the stimulus. With this model, Berlyne posits that the complexity of an image must be challenging enough to encourage interest in the aesthetic object, but simple enough to not overwhelm or frustrate the cognitive processes necessary to understand it (Berlyne, 1970, 1971). This model has been empirically applied in a number of aesthetic fields, including the

aesthetic appreciation of geometric shapes or fractals (e.g. Jacobsen, Schubotz, Höfel, Cramon, 2006; Street, Forsythe, Reilly, Taylor, & Helmy, 2016; Taylor, Spehar, Donkelaar, & Hagerhall, 2011), marketing and product design (e.g. Cox & Cox, 2002; Miceli, Scopelliti, Raimondo, & Donato, 2014; Pieters, Wedel, & Batra, 2010), and visual artworks (e.g. Marin, Lampatz, Wandl, & Leder, 2016; Osborne & Farley, 1970; Saklofske, 1975). Evidence supporting the theory suggests that a downward trend of visual interest may be due to difficulties in processing fluency when encountering more complex visual stimuli (Vissers & Wagemans, 2023). This may occur, for example, when the viewer is unable to differentiate between distinct features of an artwork, such as between distinct colour hues, and the image becomes too unintelligible to easily process (Kocaoğlu & Olguntürk, 2018). For example, in one particular study, colour information was removed from the stimuli and participants were unable to produce meaningful assessments regarding their aesthetic judgment of an object (Forsythe et al., 2011). Other studies have suggested that the effect of visual complexity on aesthetic liking may be at least partially linked to novelty in viewing (e.g. Berlyne, 1970; Miceli et al., 2014; Song, Kwak, & Kim, 2021).

Despite the number of investigations which have produced evidence supporting Berlyne's theories of aesthetic preference, there have also been several challenges to this theory and counter-evidence produced suggesting complexity as a factor is not as clearly accounted for as Berlyne has described. One of the key shortcomings to this theory arises in the form of predictability: as empirical evidence reported by Martindale, Moore, and Borkum (1990) illustrates that it is difficult to determine and generalise at what point a stimulus' complexity is optimized before it begins to weaken aesthetic preference. Taylor and colleagues (2011) attempt to mark this distinction based on the visual complexity of fractals, wherein fractal dimensions are considered as an independent factor and indicator of visual complexity. While their

findings indicate an inverse-U relationship with aesthetic preferences, an investigation by Forsythe and colleagues (2011) indicates that visual complexity as a whole still contributes to a larger portion of the variance reported in aesthetic judgments relative to fractal dimensions alone. These findings indicate that the fractal dimension may not represent the entire scope of visual complexity in aesthetic stimuli. Therefore, inconsistent evidence has failed to construct a means of evaluating and judging levels of complexity as they may pertain to the inverted-U curve.

Furthermore, more recent studies suggest a more complicated relationship between aesthetic preference and aspects of complexity. For example, in a study examining the effects of complexity on aesthetic judgment of different consumer products, Althuizen (2021) reported that aesthetic complexity reflected a negative relationship with aesthetic liking when controlling for mediating variables and covariates. Osborne and Farley (1970) describe a more straightforward, linear relationship between the two factors, while Güçlütürk, Jacobs, and Lier (2016) highlight differences between participants as influencing the liking-complexity effects. Jacobsen and colleagues (2006) also provide neurological evidence in support of a more linear relationship between beauty and complexity: according to their report, participants rated images with higher complexity as being more beautiful, and this was reflected in fMRI imaging of activations in the fusiform gyri during aesthetic judgments. Further studies have also presented contrasting evidence pertaining to the relationship between complexity and aesthetic appreciation, with some attributing deviations from the inverted-U curve to individual differences in the viewers themselves (e.g. Marin & Leder, 2018; Sherman, Grabowecky, & Suzuki, 2015; Silvia, 2005). Others consider the factors of either complexity as a concept or the aesthetic medium itself which may create this variability (e.g. Leder, Belke, Oeberst, & Augustin, 2004; Marin et al., 2016; Nadal, Munar, Marty, & Cela-Conde, 2010).

The counter-evidence to Berlyne's theory therefore suggests that the relationship between visual complexity and aesthetic judgment is complicated by medium or content-specific variables and individual factors than was previously surmised. One potential explanation for these inconsistent results is posited by Nadal and colleagues (2010). According to their investigation, visual complexity as an aesthetic component is actually comprised of three different 'types' which relate to aesthetic appreciation and beauty ratings in different ways. These types of complexity include the variety of elements displayed, the organization of those visual elements, and the symmetry of the image. This concept was later clarified and further expanded upon by Van Geert and Wagemans (2020), who consider both the subjective and objective indicators of complexity as well as its relationship with order from a multidimensional perspective. According to the authors, previous investigations of objective complexity in particular have found that individuals differ in their preferences and perceptions of objective factors (see Rump, 1968), though the extent to which each of these factors contribute to subjective ratings of complexity is still not well understood. In order to account for the influence of complexity on aesthetic preference, therefore, it is imperative that related research considers visual complexity as a multifaceted concept which is intertwined with other factors – related to both the viewer and the aesthetic medium itself – in order to influence aesthetic appreciation rather than as a predefined trend based on an ill-defined threshold.

In addition to its role in aesthetic judgment, Berlyne (1971) also attributes this upside-down U trend of visual complexity to processes of emotional and arousal responses. Arousal, Berlyne posits, is the primary underlying mechanism which determines how much 'hedonic value' – or potential reward value, pleasantness, and attractiveness of a stimulus – is assigned to an aesthetic object (1971, p.81). He describes this mode of arousal in response to aesthetics as being directly linked to and a

product of the neurological reward system (Berlyne, 1971). In support of this theory, Lacey and colleagues (2011) report neurological activation of known reward systems in the human brain – namely, the ventral striatum, the hypothalamus, and the orbitofrontal cortex – in response to viewing images of art relative to non-art images, regardless of familiarity. In addition to other studies illustrating the effects of artistic appreciation on neurological reward systems and their components (e.g. Ferreri et al., 2019; Kenett, Humphries, & Chatterjee, 2023; Vartanian & Skov, 2014), these findings contribute to a neurological model of appreciation and emotion which relies heavily on reward-based processes and affective responses (Chatterjee & Vartanian, 2016; Pearce, Zaidel, Vartanian, Skov, Leder, Chatterjee, & Nadal, 2016). In the context of awe specifically as an aesthetic emotion, positive awe experiences are conceptually linked to other instances of positive aesthetic emotions (Shiota, Keltner, & John, 2006) and have been found to activate key areas of the neural reward system (Takano & Nomura, 2022). This evidence lends credibility to its connection with arousal processes as described by Berlyne (1970, 1971).

In recent years, Berlyne's original idea of an arousal-based system of aesthetic experience has been challenged by explorations of affective responses to aesthetics, such as appraisal theories (Silvia, 2005). For example, Marin and colleagues (2016) provide some evidence for the relationship between complexity and arousal in an exploration of the hedonic value of aesthetic images of varying complexity. While they find some indication that complexity follows the inverted-U trend in relation to beauty, they found no evidence of this in other ratings associated with hedonic tone, and complexity was positively associated with arousal. Martindale and colleagues (1990), meanwhile, found no links between collative properties, such as complexity, and aesthetic preference; rather, their results indicated a strong effect of semantic information on preference and arousal.

It is therefore essential to consider the role visual complexity may have during aesthetic judgment and awe experiences when it comes to evaluating stained-glass windows. While a large portion of research supports Berlyne's (1971) theory of an upside-down U trend, we have seen that other evidence suggests that the influence of complexity may not be so easily explained. Accordingly, the present research will examine preferences and emotional responses towards stimuli of varying complexity in stained glass, a less-explored medium of art and aesthetics. The present study draws upon Nadal and colleagues' (2010) and Van Geert & Wagemans' (2020) description of different 'types' of complexity; here, we investigate visual complexity as it relates to the influence of the quantity and variety of elements displayed in each stimulus image on both aesthetic judgment and awe experiences.

2.1.1.2 Perceived Scale

The second characteristic to be considered for the purposes of the present study is that of perceived scale, whether this refers to the veridical size of a visual stimulus or the concept of the stimulus representing something larger. For our purposes, we refer to *perceived scale* mainly in terms of the spatial or conceptual physical size of an aesthetic object (Tong, Loh, Liang, & Kumada, 2016) rather than in terms of the subjective implications of the object's size or power in relation to the viewer (Keltner & Haidt, 2003), as this relates more closely to the context and subject matter of the experience being depicted (Szubielska, Imbir, & Szymańska, 2021). It is noted, however, that these implications are considered in later chapters in relation to how top-down and bottom-up differences between viewers across different stimuli may influence different aesthetic experiences and emotional responses (see Chapters 3 and 4).

Research on specific characteristics of aesthetic liking has suggested that the observer of an artistic object or scene may be highly influenced by how large they perceive it to be, especially in relation to

themselves and in association with the artist's perceived skill and experience (Seidel & Prinz, 2018). In one study examining aesthetic preferences according to object size alone, researchers found a significant preference for larger abstract stimuli when given the choice between two images (Silvera, Josephs, & Giesler, 2002). This effect was observed among adult and 3-year-old participants, was reported as significant regardless of differences in visual complexity between object types, and was only interrupted when the stimuli were assigned meaning through comparisons to similar stimuli of a different size during the preference task, such as when stimuli assigned to a 'large' condition for one group of participants were assigned to the 'small' condition for another. While Palmer, Schloss, and Sammartino (2013) attribute significant effects of scale to a theory of perceptual fluency – wherein aesthetic objects are liked and appreciated to the degree that they are most easily perceived – the counter-evidence presented by others, such as Clarke, Shortess, and Richter (1984), indicate that this may not be the case.

While the majority of the research on this topic indicates a positive relationship between affective aesthetic experiences and perceived scale (e.g. Konkle & Oliva, 2011; Seidel & Prinz, 2018; Silvera et al., 2002), some investigations have reported that other factors, such as context, may influence the relationship between scale and aesthetic liking during the evaluation process. In his characterization of the sublime – an aesthetic concept strongly linked with awe - Konečni (2005) addresses both the influence of an aesthetic object or scene's physical size and the context in which that experience takes place. Brieber, Nadal, Leder, and Rosenberg (2014) explored the effects of external context in relation to viewing time and reported that, in a comparison between a laboratory and a museum context, artworks viewed in a museum were viewed longer, were rated as more interesting, and were liked more than those in the laboratory. Similar effects are also reported by Szubielska and

Imbir (2021), who found that viewing a critical art piece in an art gallery context elevated affective responses and aesthetic liking in comparison to a laboratory setting (see also Swami, 2013; Szubielska et al., 2021). These observed effects of context may explain certain discrepancies in the literature, such as the counter-evidence reported by Clarke and associates (1984) that only viewing distance, and not objective image size, influenced preference for an artwork. In other words, changes in where the viewer was positioned – not the scale of the artwork itself – influenced aesthetic perception.

Considering this, it is important to explore the possibility that scale may be contextual like other bottom-up variables such as symmetry, complexity, position or distance from the viewer, and framing. As stated previously, Silvera and colleagues (2002) reported that, when context was provided, the effects of scale in stimuli were disrupted and preferences were more directly influenced by the representation assigned to each stimulus. The effects of stimulus size – especially in an artistic context – were later re-established by Seidel and Prinz's (2018) investigation, but their research aims did not consider the role of context in aesthetic appreciation. Therefore, future research may seek to consider to what extent objective size affects aesthetic experiences.

Perceived scale, therefore, may be considered in this case as a factor which may influence both aesthetic judgment and awe responses to stained-glass windows, particularly given that the context featured in the following chapters is restricted to a computer screen in either a lab or a non-controlled setting. With these considerations in mind, it is suggested that images of stained-glass windows which are widely perceived to be large in scale – even in the context of a computer screen - may be more likely to induce positive aesthetic and emotional responses.

2.1.1.3 Subjective Novelty and Familiarity

The final aesthetic characteristic to be considered in this chapter is the effect of stimulus novelty on aesthetic evaluation and emotional responses. When referring to the effects of novelty, it is important to consider the key differences between category-specific novelty and subjective novelty. Here, subjective novelty refers to a lack of familiarity with the specific stimulus in question, be it a specific painting (Berlyne, 1970) or other aesthetic object such as a geometric shape (Berlyne & Parham, 1968). Subjective novelty and affective responses related to subjectively-novel stimuli are occasionally examined by means of the 'mere exposure' effect, where the same or similar stimuli are either repeatedly rated for their aesthetic evaluation or a conditional priming task is applied prior to initial viewing (Berlyne, 1970; Bornstein & D'Agostino, 1992; Faerber et al., 2010). This effect is illustrated in Peskin and Newell's (2004) investigation into how repeated exposure affects the attractiveness of facial features. Their findings indicate a positive relationship between subjective familiarity and attractiveness of faces.

Category-specific novelty, on the other hand, refers here to a lack of familiarity with the type of stimulus or aesthetic medium presented based on aesthetic experience (Leder et al., 2004) or knowledge of context (Aspers, 2006). This type of familiarity is often attributed to 'experts' in a particular field of aesthetics, such as art historians (e.g. Commare et al., 2018; Furnham & Walker, 2000; Leder et al., 2019; Pazzaglia et al., 2021; Silvia, 2013) or professional artists (e.g. Cupchik & Gebotys, 1988; Furnham & Walker, 2000; Hekkert & Van Wierengen, 1996; Leder et al., 2019). The effects of category-specific novelty or familiarity are discussed further in Chapter 3 as they relate to the role of expertise in aesthetic perception. Here, we focus on subjective novelty as it refers to aesthetic preferences and emotional responses.

Regarding aesthetic judgments, research has shown that subjective, item-specific novelty is a strong indicator of aesthetic

preference (e.g. Berlyne, 1971; Hekkert et al., 2003). In his theory of arousal as the underlying determinant of aesthetic preference, Berlyne (1971) suggests that as novelty decreases with repetitive interactions with the aesthetic object, so does aesthetic appreciation as a result of the reward and aversion arousal processes involved in addressing new stimuli. This view is supported by evidence drawn from Cupchik and Gebotys' (1990) investigation into dimensions of interest and pleasure, which depicts novelty as a key dimension of aesthetic interest because it minimizes boredom with a stimulus. This attribution to reward and aversion, however, is challenged by Silvia (2005b), who addresses the pitfalls of modern research on arousal and motivation. These pitfalls, which Silvia notes discredit the attribution of aesthetic responses to reward-based systems, do not diminish the significance of considering novelty and other collative variables from another, more cognitively grounded viewpoint. They do, however, call for a different attribution of origins and the processes underlying their influence in aesthetic judgment.

Appraisal theories (discussed already in Chapter 1) consider the role of subjective novelty as a top-down cognitive-affective process dependent on the observer's evaluation and understanding of a stimulus (Leder et al., 2004; Leder & Nadal, 2014; Silvia, 2005b). This model of aesthetic appreciation and judgment lends itself to investigations of novelty in aesthetic judgment because it addresses the observer's subjective experience of a stimulus' objective features (Silvia, 2005b). Silvia (2006) cites novelty as one of two primary appraisals of aesthetic interest, with the other being comprehensibility as opposed to objective complexity. Evidence supporting this theory may be found in the manner in which novel stimuli are interpreted and preferred. For example, Park and colleagues (2010) report that preferences for familiar stimuli were higher for images of faces, but lower for scenes. Song and associates (2018) explored this further using paintings, finding that participants

preferred familiar paintings when it came to portraits but preferred novel paintings when shown abstract art, and this was significantly modulated by the level of complexity in the painting. Furthermore, familiarity-based preferences may be heavily influenced by other factors, such as the level of complexity depicted (Berlyne, 1970; Silvia, 2005b; Song et al., 2021), content (Song et al., 2021), or how spontaneous and instinctive the judgment provided is (Leder, 2001). Therefore, while novelty certainly has a place in appraisal theories of aesthetics, it should be considered in the context of other variables.

Because novelty appears to be an important factor in both aesthetic judgment and the eliciting of awe, it is important to consider stimuli which would possess a higher likelihood of being unfamiliar to the majority of viewers participating in our empirical investigations. This is especially the case when recruiting participants with specific experiences viewing, studying, and judging specific stimuli in the relevant category, whereas it may not be as important a consideration when recruiting without a consideration for expertise influences. For our purposes, considerations of potential stimuli may be more limited for experiments addressing influences of expertise and familiarity with the category of art than those that do not consider them directly.

2.1.2 The Present Study

The aim of this study was to examine aesthetic judgments and emotional responses to stained-glass windows by assembling a workable database of stimuli based on controllable or measurable aesthetic features. The intention, therefore, was to select a sample of stimuli from available resources based on three inclusion criteria: perceived as relatively large in scale, unfamiliar to the observer, and either within the higher or lower quartiles of relative complexity in order to create a comprehensive database of stained-glass window images which could be used in later experiments. It was hypothesized that, given a particular sample, distinctions of complexity, perceived scale, and familiarity would

be reported and enable the assembly of a database specifically curated for studies of emotional and aesthetic responses for the purposes of the current thesis.

2.2 METHODS

2.2.1 Participants

43 participants (23 females, age range 20-65 years, Mean age = 36.44years, SD = 11.2 years) were recruited from Prolific, an online recruitment platform, to take part in the study. Participants were recruited from the site based on their eligibility, based on the demographic information. Eligibility criteria included being over 18 years of age, having no prior history of optically-induced migraines or neurological photosensitivity disorders (i.e. epilepsy), and having normal or corrected to normal colour vision. We also required all participants to complete the study on a laptop or desktop computer. Participants' demographic information was anonymized.

The sample size was determined based on a prior power analysis and counterbalancing efforts to yield equal responses across all stimuli. Participants were all based in Ireland in order to explore familiarity effects with Irish stained-glass windows. All participants were compensated at a rate of between £9.50 and £10.60 per hour. During the testing procedure, 24 participants ended the experiment prematurely, 2 participants timed out of the study, and 7 were rejected after completion due to insufficient data. From the recruitment sample, a further three participants were excluded due to reported technical issues with running the experiment, leaving a final sample of 40 participants (22 females, age range 20-65 years, M = 35.4, SD = 10.8).

2.2.2 Design

We adopted a within-subjects design in which all participants received a series of closed-ended survey questions in the form of several seven-point Likert scales, with points ranging from 'strongly disagree' (1) to 'strongly agree' (7). A total of 6 questions were presented following viewing of an image of a stained-glass window. These questions are listed in Table 2.

Five questions focused on perceived scale, perceived uniformity of the window's lighting, familiarity with either the scene depicted or the window itself, and visual complexity of the image as it relates to colour variety (CCOM) and number of glass pieces observed (NCOM). The focus of the present investigation were the questions relating to CCOM, NCOM, perceived scale, and familiarity with the specific window; results of the other items listed are recorded elsewhere. The independent variables of this study consisted of exactly 160 images shown in a randomized order to participants, with 40 images being randomly chosen from the full sample to be shown to each participant. Each image was shown with questions provided as part of the survey portion, which were the same across all presented stimuli. Presentation order of the questions – which are listed in Table 2-1 - were random for each trial. The dependent variables were the responses to each survey question per image shown. Each participant viewed a random set of 40 images out of the total 160 in the data set. On average, the experiment took 25 minutes and 23 seconds to complete.

INDEX	**STATEMENT**
1	This window is much larger than an average adult.
2	The lighting of this window is equally distributed.
3	Due to the number of different colours used, this window is complex.
4	Due to the number of pieces of glass used, this window is complex.
5	I am familiar with this specific window.
6	I am familiar with the story and/or character(s) depicted in this window.

Table 2-1: Statements utilized in present experiment, assessing factors of familiarity (questions 5-6), complexity (questions 3-4), perceived scale (question 1), and brightness of each image (question 2). Statements were

shown an equal number of times in a randomized order per image. This paper examines items 1, 3, 4, and 5 only; other items are discussed elsewhere.

2.2.3 Stimuli

From a larger corpus of 5,473 images of various religious stained-glass windows from around Dublin, Ireland, 160 images were chosen which were free of text, obstructing objects or figures, and uneven lighting. The images were edited for luminance and resolution using Adobe Lightroom. The original proportions of the images were preserved but all images were resized to a height of 950 pixels during the preview stage of the experiment and 600 pixels during the rating stage.

2.2.4 Procedures

The experiment was programmed using PsychoPy, an open-source software package, and was uploaded to the survey sharing site Pavlovia for online distribution. Before the experiment began, two practice trials containing unrelated images of two different paintings were shown, and a set of statements was provided alongside each of them in order to acquaint participants with the procedures of the experiment.

Experimental trials began with the presentation of a white fixation cross in the centre of a black screen for 1,000ms. Participants were instructed to focus their gaze on the cross until an image of a stained-glass window appeared. This image remained on screen for 5,000ms. Following this initial presentation, a smaller version of the image remained on the screen along with six statements which were presented one at a time (see Table 2). Participants were asked to respond to each statement using a one-to-seven Likert scale. Once every statement had been answered, a new trial started.

2.3 RESULTS

Following data collection, the results for each stimulus image were averaged across all responses and analysed for basic descriptive data in order to determine which items were most highly rated (as well as lowest-rated for visual complexity only) for each dependent variable in order to meet inclusion criteria. The results of these analyses are described below.

2.3.1 Visual Complexity Results

The distribution of rating responses to questions relating to visual complexity are presented in Figures 2.4 and 2.5 below. The data for both were not normally distributed, $W = 0.942$, $p < 0.01$ for CCOM and $W = 0.959$, $p < 0.01$ for NCOM. The skewness of CCOM was found to be -0.868, while the skewness of NCOM was found to be -0.638, indicating that both distributions were left-skewed. The kurtosis of CCOM was found to be 3.402, while the kurtosis of NCOM was reported as 2.822. The distributions of average responses across stimuli for both CCOM and NCOM are illustrated in Figure 2-1 and Figure 2-2, respectively. Supplementary data was calculated to determine the predictive relationship between the two complexity questions as factors of visual complexity; these results are presented in Appendix B.

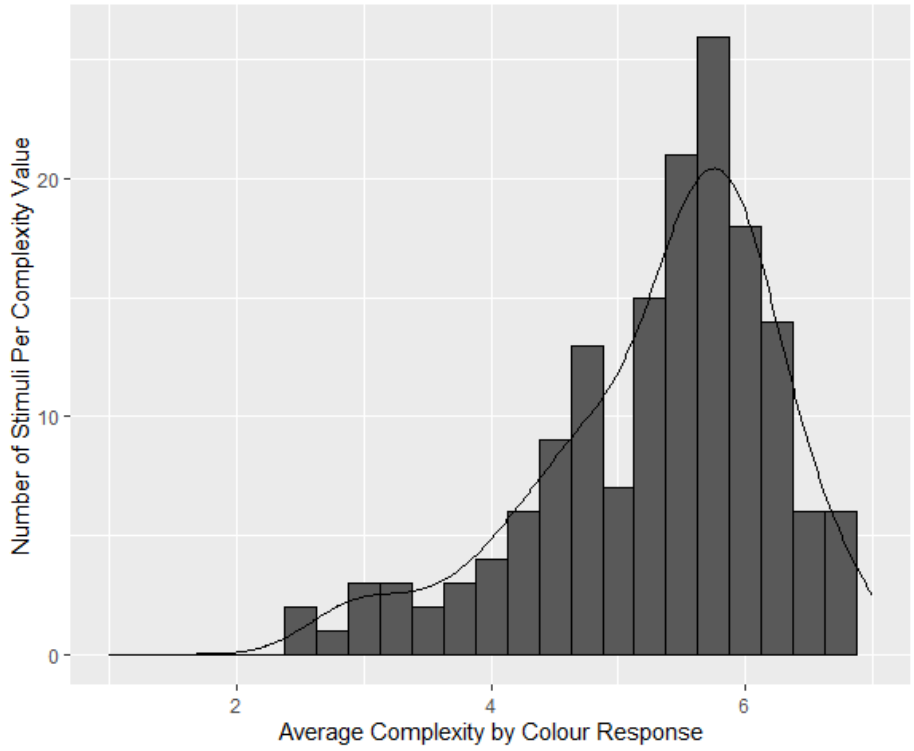

Figure 2-1: Distribution of the average responses to complexity as defined by the number of colours featured in each stimulus image.

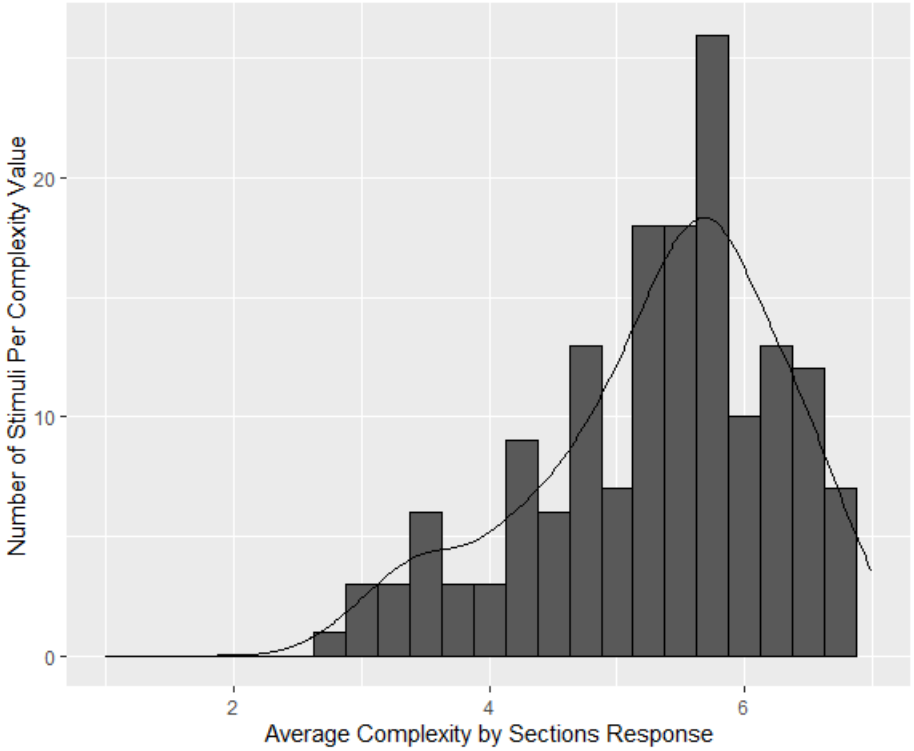

Figure 2-2: Distribution of the average responses to complexity as defined by the number of glass pieces featured in each stimulus image.

In order to investigate the influence of complexity levels within the context of the experiments considered later in this thesis (see Chapters 3 and 4), a quartile split was conducted and windows featured in either the upper and lower quartiles of both CCOM (m = 5.400, IQR = 4.900, 5.925) and NCOM (m = 5.550, IQR = 4.800, 5.925) were selected from the variable set. In total, 31 windows for high-complexity in both conditions (M = 6.370, SD = 0.277) and 31 windows for low-complexity in both conditions (M = 3.900, SD = 0.535) were selected which met the criteria for both conditions, resulting in a total of 62 windows meeting the criteria for this condition.

2.3.2 Perceived Scale Results

The distribution of rating responses to the perceived scale question are presented in Figure 2-3 below. Responses indicating the perceived size of the windows were not normally distributed (M = 5.100, SD = 1.510); indeed, they were right-skewed at -0.297, and had a kurtosis of 3.149.

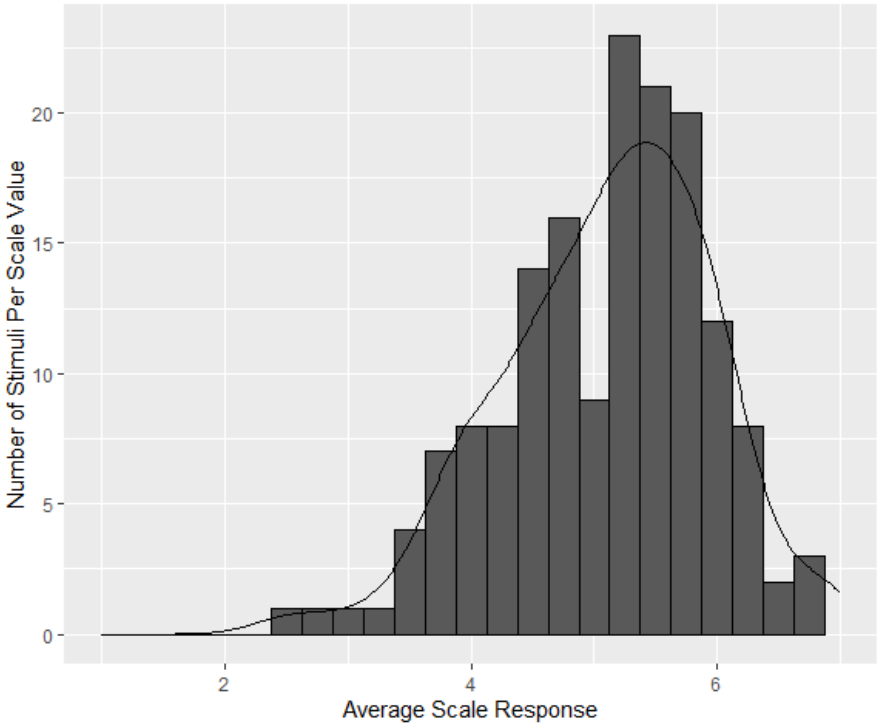

Figure 2-3: Distribution of the average responses to perceived scale of each stimulus image.

Images were chosen based on a median split (m = 5.100), where images perceived to be larger relative to the rest of the sample were selected. In total, 80 images from the sample met these criteria (M = 5.77, SD = 0.416).

2.3.3 Subjective Novelty Results

The distribution of rating responses to the familiarity with the specific window question are presented in Figure 2-4 below. Reported familiarity with the windows themselves was not normally distributed (M = 2.520, SD = 0.710) and was right skewed at 0.616, with a kurtosis of 2.873.

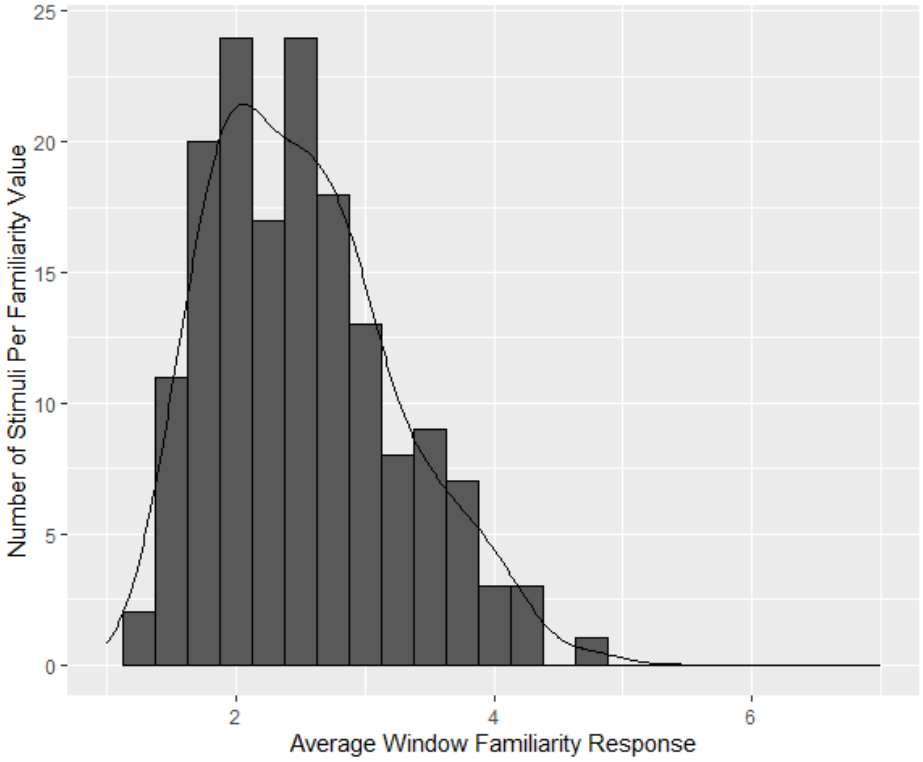

Figure 2-4: Distribution of the average responses to familiarity with the window itself for each stimulus image.

Images were chosen based on a median split (m = 2.4), where windows perceived to be more familiar relative to the rest of the sample were excluded in favour of relatively-unfamiliar windows. In total, 80 images were selected based on these conditions (M = 1.95, SD = 0.289).

2.3.4 Overall Stimulus Selection

In total, 28 images from the original sample of 160 met the initial three inclusion criteria: perceived as relatively large in scale, unfamiliar to the observer, and either within the higher or lower quartiles of relative complexity. Of this final sample, 22 images were categorized as 'high complexity' stimuli, while 6 images were categorized as 'low complexity' stimuli.

Familiarity results were applied only in consideration of category familiarity and its effects (discussed further in Chapter 3). Of the 28-item sample selected from the initial 160, only 18 images (13 high complex, 5 low complex) also met the criteria outlined in Section 2.3.3. These stimuli are considered and discussed further in the next chapter.

In order to create a balanced sample between the two complexity groups, 16 further images of Irish stained-glass windows were selected from various online databases based on the same criteria examined in the present study. These images were selected from churches in Co. Wexford (n = 5), Co. Donegal (n = 3), Co. Belfast (n = 2), Co. Galway (n = 2), Co. Down (n = 1), Co. Offaly (n = 1), Co. Kilkenny (n = 1), and Co. Dublin (n = 1). The final number of stimuli to be used in the context of this thesis was 44.

2.4 DISCUSSION

The purpose of the present investigation was to intentionally select from an existing database of religious stained-glass windows stimuli which, based on subjective ratings, would be most likely to elicit feelings of awe and aesthetic judgments of beauty and liking. As expected, the factors of visual complexity considered in this investigation – the number of colours depicted (CCOM) and the number of separate sections or panels included in the image (NCOM) – strongly predicted each other, and images rated as high in one factor were, most often, also rated as high in the other. Examining these factors individually contributed both to our understanding of the feature characteristics which contribute to overall complexity and our exploration of which specific stimulus images met this definition.

As has been described in Section 2.3.1 and is illustrated in Figures 2-1 and 2-2, the majority of the images presented were rated as visually complex on either one or both factors. This may indicate that the sample we considered happened to contain more visually complex windows than is typical for the medium, or it may reflect a pattern of complexity which may be characteristic of the majority of stained-glass windows. A more expansive exploration of complexity within the medium – such as that conducted in other mediums of visual aesthetics (e.g. Commare et al., 2018; Fekete et al., 2022; Forsythe et al., 2011; Kocaoğlu & Olguntürk, 2018; Marin & Leder, 2013, 2016; Nadal et al., 2010) – may address whether trends of complexity in prototypical stained-glass windows tend to be considered as more visually complex overall or if our group of images represents a particularly complex sample.

In addition to visual complexity, we also explored whether, based on images of stained-glass windows with all context but the windows themselves removed, participants would be able to make judgments regarding scale and subjective novelty. Much like visual complexity, the ratings of both of these variables were highly skewed wherein the

majority of stained-glass windows were rated as perceptively large and unfamiliar. One explanation for the first of these findings may relate to the perceived skill of the glass painters or designers of the windows: as Seidel and Prinz (2018) report, visual art pieces are more likely to be perceived as larger if they are presented as reflecting a higher level of skill. Without context, it may be possible that participants presumed stained-glass windows were larger if they were perceived as being produced by someone with a higher level of technical skill. However, no information was collected during the course of the present study to examine this potential relationship.

Regardless, the results of the present investigation provided a means of selecting stimuli which were perceived as larger and unfamiliar to the majority of viewers. This data, along with the visual complexity ratings, were considered in order to select windows which met all three criteria so as to provide the best possible means of eliciting awe responses and aesthetic liking. In doing so, we provide a controlled sample of images with which to examine aesthetic and affective responses in a laboratory or uncontrolled setting by including features which are known to contribute to aesthetic appreciation and awe experiences.

2.4.1 Limitations & Further Study

In consideration of these implications for future research, some limitations of the present investigation should be addressed. First, as illustrated in Section 2.3, the variables examined in this investigation were not normally distributed, with the majority of the original stimulus sample being rated as highly unfamiliar, perceptively large, and highly complex in both colour and the number of sections shown. The overwhelming skewness of our results indicate that our initial sample of 160 images may not be representative of the art form as a whole, and the separation between higher and lower ends of the spectrum for all three factors is relative to the full scale of responses. Future research

may aim to investigate whether these results are indicative of the properties of stained-glass being more complex, larger, and more unfamiliar than other art forms, or whether the present sample is representative of the wider medium.

One further point to note is that the means for rating visual complexity here is entirely subjective and based on the viewers' own appraisals. While efforts were taken to phrase response statements in a manner that minimized confusion and provided a point of focus for the observer to consider, it is possible that definitions of what is complex (especially relative to other windows in the sample) may vary among viewers. Nadal and associates (2010) report that, when viewing and rating abstract and representational art, visual complexity is defined by the number of elements presented in an image, the organization of those elements, and the amount of symmetry in the image, with the first of these factors being most significant for measuring overall visual complexity (see also Berlyne et al., 1968; Fekete et al., 2022). As Van Geert and Wagemans argue, however, using subjective measures to distinguish between stimuli of varying complexity has the disadvantage of being heavily reliant on the influence of individual differences in appraisals. Therefore, it is important for future researchers to produce as accurate a range of stained-glass window stimuli as possible in regards to this aesthetic factor.

As an alternative to subjective ratings, several objective measures for visual complexity exist which, if utilised in future investigations, may be able to explore trends of complexity further. One such method of measuring objective complexity, was proposed by Machado and Cardoso (1998) and validated on several occasions by researchers in aesthetics (e.g. Carballal et al., 2020; Forsythe et al., 2008, 2011; Gartus & Leder, 2017; Lazard & King, 2020; Marin & Leder, 2013; Machado et al., 2015). The approach here is to compress the file into a digitalized image format – typically a GIF or JPEG – and calculate the amount of detail contained

in an image based on the amount of error produced during the compression process. During the compression process, a set amount of error in image quality is generated based on how predictable the pattern of pixels are in the image. If there is a greater variety of pixels, this would result in a greater margin of error in image quality and thus denote a greater degree of complexity. This method has been positively correlated with subjective ratings of visual complexity (e.g. Forsythe et al., 2008, 2011; Machado et al., 2015; Marin & Leder, 2013), indicating its ability to predict perceptions of complexity among viewers.

Another means of measuring objective complexity is a statistical test of image properties known as the pyramid of histograms of orientation gradients (PHOG; Amirshahi et al., 2012; Braun et al., 2013; Redies et al., 2012). This calculates visual complexity by comparing how similar the image as a whole is to each of its individual parts based on features of complexity, including luminance and colour variety. This method has been used in several investigations examining objective measures of complexity in aesthetics (e.g. Amirshahi et al., 2012; Chamberlain et al., 2018; Coburn et al., 2020; Hayn-Leichsenring et al., 2017; Redies, 2015; Redies et al., 2020), and it has been found to be highly correlated with fractal dimension, another feature of visual complexity (Braun et al., 2013). However, because these measures of objective complexity have not been widely generalized within the field of aesthetics (Van Geert & Wagemans, 2020), it was unknown how well they would predict the visual complexity of an as-yet unexplored artistic medium. Therefore, the present study relied on subjective measures as an initial means of distinguishing between levels of visual complexity in stained-glass windows.

While the present thesis attempts to control for perceived scale and subjective novelty by selecting only stimuli which met the criteria for perceptively-large and relatively unfamiliar stimuli, complexity – as a less understood factor of both aesthetic liking and awe – is considered

as a point of interest for the present investigations. The uncertainty surrounding its role as an influence of aesthetic perception, especially as it interacts with other properties of the aesthetic object (Marin et al., 2016), makes visual complexity a necessary variable to account for, if not control entirely in the following experiments.

In addition, the present stimuli were selected based on variables of interest for the specific investigations outlined in Chapters 3 and 4 of this thesis, which included exclusion criteria such as text. Therefore, the sample provided may not be generalizable to other experimental aims outside the scope of this project which may focus on more cognitive processes involved in viewing stained-glass windows. This is especially true in consideration of potential cultural and religious differences, as all stained-glass windows considered within the scope of this study are based in churches within either the Republic of Ireland or Northern Ireland and contain Christian subject matter. However, the authors intend the selected images to provide a springboard sample of windows and guidelines for selection that future research considering similar aims may avail of and expand upon with larger, more globally and culturally representative samples.

2.5 CONCLUSIONS

Stained-glass windows are a complex artistic medium which have yet to be empirically investigated for their aesthetic value. The unique properties of the prototypical stained-glass window provide researchers with the opportunity to explore not only how specific aesthetic characteristics – such as size and complexity – are reflected throughout various examples of the medium, but also how they influence aesthetic appreciation of individual stimuli. The study described in the present chapter takes the first step in approaching an empirical investigation of this medium by providing an initial sample of from which to draw upon for this and future investigations.

The examples drawn from this preliminary study will now be used to investigate differences in aesthetic judgment and affective responses as they relate to bottom-up and top-down features of stained-glass windows. While attempts will be made to control for from the influence of perceived scale and subjective novelty by selecting images that are more likely to inspire awe and aesthetic liking based on these two factors, current debates surrounding the role of complexity mean its influence should be considered as a potential covariate. By controlling and accounting for these features, it is possible to narrow the focus of effects for future experiments on top-down, observer-based factors, such as expertise and religiosity. By incorporating the images chosen as a result of this investigation, these primary variables of interest are considered in the next few chapters.

CHAPTER 3: TO WONDER AND STAND RAPT IN AWE: DIFFERENCES IN AWE AND PUPIL DILATION BETWEEN EXPERTS AND NON-EXPERTS

3.1 INTRODUCTION

3.1.1 The Role of Expertise: a Reoccurring Subject in Aesthetic Research

In research on aesthetics, one prevalent topic of interest is the differences between individuals with expert knowledge, experience, and insight about an artwork or art medium and individuals with little to no prior knowledge or experience. As Leder and colleagues (2004) describe in their model of aesthetic appreciation, the prior knowledge and experience which experts possess aids them in their perceptions of an artistic object's stylistic, organizational, and formal value in order to formulate their judgment about the object's aesthetic value. The role of acquired knowledge about stylistic and formal components of an artwork has also been shown to mediate positive aesthetic judgments as the viewer's understanding of what they are viewing expands (Swami, 2013), though these effects are also reliant on pre-existing levels of expertise (Belke, Leder, & Augustin, 2006).

One element of this process which may shed some light on why relative experience as is observed in art experts may possess such a strong influence on how art is interpreted may relate to the concept of category familiarity. As discussed in Chapter 2, category familiarity here refers to the level of familiarity and experience an individual possesses with the typical elements – often referring to style, organization, and other formal and conceptual components – of an aesthetic category, which they can use to formulate judgments about how representative and typical the example is of that category (Hekkert & van Wieringen, 1990). Experts in specific category identification have shown less confusion and difficulty interpreting and judging abstract examples of

that category than non-experts, who tend to prefer more representational examples (Silvia, 2013). On the other hand, examples which deviate from experts' internal representations of a category are rated as less attractive and more accurately identified as 'abnormal' by experts than by nonexperts (Diel & Lewis, 2022). This ability to determine the prototypicality of an aesthetic object is highly related to ratings of beauty, wherein the more 'typical' an object is of a given category, the more it is aesthetically appreciated. This suggests that individuals who possess a broader understanding of prototypical examples of a given category would be better equipped to address formal components in their aesthetic evaluation (Hekkert & van Wieringen, 1990).

The influence of expertise on aesthetic appreciation appears to be so potent that it mediates the effects of other variables which would otherwise have an effect, including cultural differences (Darda & Cross, 2022), visual complexity (Walker, 1981), and the degree of realism applied in the artwork (Hekkert & van Wieringen, 1996). The reason why this may be the case may relate to the advanced ability of experts to consider an expansion of elements beyond the subject of the work (Leder, Gerger, Dressler, & Schabmann, 2012). As Leder and colleagues (2004) note, experts are more well-versed in the formal components of an artwork or aesthetic object and can consider how they are utilised during aesthetic evaluation, whereas nonexperts tend to only consider the subject matter and other surface-level elements of an aesthetic object. This is best illustrated in considerations of how experts and nonexperts differ in their evaluations of abstract versus representational art: numerous studies have shown that experts tend to prefer and appreciate abstract artworks more than nonexperts do (e.g. Bimler, Snellock, & Paramei, 2019; Darda & Cross, 2022; Leder et al., 2012; Pihko et al., 2011; Silvia, 2013; Van Paasschen, Bacci, & Melcher, 2015).

In addition to aesthetic preferences and judgments, expertise has also been examined in the context of aesthetic emotions and how art evokes emotional experiences, including when it comes to how individuals respond to positively and negatively-valanced artworks. For example, Leder, Gerger, Brieber, and Schwartz (2014) report that individuals who scored higher in art expertise tended to not only experience less intense emotions in response to positively and negatively valanced art (i.e. art which contains emotionally positive imagery and symbolism in comparison to art which contains emotionally negative imagery and symbolism), but they also tended to like negatively-valanced art more than non-experts did, indicating an influence of the formal components of the artwork over the content. These results further indicate art experts' reliance on artistic components over subject matter for their evaluations and responses, wherein the stylistic and formal elements of the work override the emotional responses which nonexperts – who are less equipped to appreciate these elements – experience. This is further shown by Leder, Gerger, Dressler, and Schabmann (2012), who report that, in general, nonexperts reported more intense emotions in response to art than experts except in the case of abstract art, wherein the emotional responses of experts were more intense. These investigations support the idea that experts base evaluations of artworks on their understanding of the components which make up that artwork rather than the subject of the artwork itself, thus resulting in higher ratings of preference (especially for abstract artworks) but less intense emotional responses in comparison to non-experts.

The exploration of expertise as a mediating factor of aesthetic appreciation remains a topic of discussion for how people form aesthetic judgments, especially as it relates to affective responses to art and artistic objects. One emotional experience which has not yet been fully investigated in relation to expertise has been the complex experience of

awe. As Silvia, Fayn, Nusbaum, and Beaty (2015) discuss, the relationship between awe and expertise would be well-worth examining as it relates to an artwork's potential to induce awe. On one hand, the authors argue, the experts' increased ability to understand and interpret the formal components of the artwork would give them access into more information about the stimulus than nonexperts would be privy to, which could, therefore, increase the level of perceived 'vastness' or overwhelmingness of the artwork as it relates to the technical skill of the artist and the intention behind the work's meaning. On the other hand, having access to this knowledge and being aware of prototypical examples within the artistic category may make this additional information easier to accommodate mentally, thereby removing the need for accommodation element necessary for awe experiences. These contradictory effects illustrate the importance of studying awe in relation to art expertise, as doing so can assist researchers both in understanding how awe experiences are elicited based on individual differences and how expertise impacts aesthetic emotions in comparison to nonexperts.

3.1.2 Eliciting Awe and Aesthetics

As discussed in Chapter 1, awe is a complex emotion which relies on factors of vastness – either physical or conceptual – and a need for mental accommodation in order to be elicited (Keltner & Haidt, 2003). When discussing awe in relation to aesthetic features, we turn again to consider the roles of complexity, scale, and novelty and how variations of all three may incite an awe experience in the viewer.

The first feature to be considered here is visual complexity. In addition to his theories on aesthetic judgment (as discussed in Chapter 2), Berlyne (1971) attributes the idea of the upside-down U trend of visual complexity to emotional arousal responses. Arousal, Berlyne posits, is the primary underlying mechanism which determines how much 'hedonic value' – or how pleasant or potentially rewarding a

stimulus is – is assigned to an aesthetic object (1971, p.81). He describes this mode of arousal in response to evaluating an aesthetic object as being directly linked to and a product of the neurological reward system. In support of this theory, Lacey and colleagues (2011) report neurological activation of known reward systems in the human brain – namely, the ventral striatum, the hypothalamus, and the orbitofrontal cortex – in response to viewing images of art relative to non-art images, regardless of familiarity. In addition to other studies illustrating the effects of artistic appreciation on neurological reward systems and their components (e.g. Ferreri et al., 2019; Kenett, Humphries, & Chatterjee, 2023; Vartanian & Skov, 2014), these findings contribute to a neurological model of appreciation and emotion which relies heavily on reward-based processes and affective responses (Chatterjee & Vartanian, 2016; Pearce, Zaidel, Vartanian, Skov, Leder, Chatterjee, & Nadal, 2016). Positive awe experiences are conceptually linked to other instances of positive aesthetic emotions (Shiota, Keltner, & John, 2006) and have been found to activate key areas of the neural reward system (Takano & Nomura, 2022). This evidence lends credibility to awe's connection with arousal processes as described by Berlyne (1968, 1970, 1971).

In the context of awe, there are few investigations which have attempted to support Berlyne's inverted-U model of visual complexity. While Berlyne does not discuss awe specifically, he does cite the aesthetic event of the 'sublime' as it is defined by Burke (1757) and Kant (1790/2003), which is conceptually linked to awe (Konečni, 2005). From Berlyne's perspective, experiencing a 'sublime' aesthetic experience is enough to partially inhibit the neurological aversion centres in the brain which would otherwise posit a threat of some kind to the viewer (1971). He refers to characteristics of an aesthetic awe elicitor rather than the emotional experience itself, which Konečni (2005) interprets as part of the 'stimulus-in-context' in the case of the sublime.

This, however, assumes that elicitors of awe are similar, if not entirely identical, in nature and intensity as elicitors of aesthetic appreciation. Considering that awe eliciting factors are generally reliant on a complex, information-rich stimulus as it relates to the cognitive functions underlying such experiences (Keltner & Haidt, 2003; Shiota, Keltner, & Mossman, 2007), it may not be realistic to expect that awe experiences would follow the same inverted-U relationship that Berlyne describes for aesthetic judgment (Silvia, 2005). Indeed, empirical evidence considering complexity and awe responses in aesthetic contexts (e.g. Price, Greenslit, Applebaum, Harris, Segovia, Quinn, & Krogh-Jespersen, 2019) as well as non-aesthetic contexts (e.g. Gordon, Stellar, Anderson, McNeil, Loew, & Keltner, 2017) indicate that stimuli with higher visual complexity are more likely to elicit awe than lower complexity stimuli, which would support the concept of awe as a cognitive emotion that facilitates learning and the pursuit of knowledge (Gottlieb, Keltner, & Lombrozo, 2018; Valdesolo, Shtulman, & Baron, 2017). It appears from the consideration of this evidence, therefore, that awe and visual complexity are clearly related, especially as complexity contributes awe characteristics (Rivera, Vess, Hicks, & Routledge, 2020).

The second aesthetic factor known to elicit awe experiences is perceived scale (Shiota et al., 2007). When Keltner and Haidt (2003) posit their theoretical definition of awe, they include the necessary variable of vastness – either perceptual or conceptual – which overwhelms the viewer. This is illustrated in studies examining awe whilst viewing landscapes (e.g. Kirillova & Lehto, 2015; Kirillova, Fu, Lehto, & Cai, 2014; Pearce, Strickland-Munro, & Moore, 2017; Silvia, Fayn, Nusbaum, & Beaty, 2015; Smalley & White, 2023; Wang & Lyu, 2019) or architectural structures (e.g. Joye & Dewitte, 2016; Joye & Verpooten, 2013; Krogh-Jespersen, Quinn, Krenzer, Nguyen, Greenslit, & Price, 2020; Negami, 2016; Negami & Ellard, 2023). For example,

Negami and Ellard (2023) report that features associated with physical size – such as the height of the ceiling or the area of the room – are among the qualities of architecture which evoke awe through their contribution to creating a space that is vast in both conception and physicality. Such findings are especially interesting in relation to awe experiences as it relates to the phenomenon of the 'diminished self' which is often experienced in response to awe-eliciting stimuli (Bai et al., 2017; Piff et al., 2015; van Elk, Karinen, Specker, Stamkou, & Baas, 2016). These reported effects, while most obvious in cases where physical space is considered, have also been demonstrated in observations of visual art, such as paintings. In their exploration of the relationship between the perceived size of an artwork and aesthetic judgment, Seidel and Prinz (2018) report that ratings of awe were strongly associated with the largeness of the artwork presented to participants, both when controlling for the objective size of the work and when asking participants to estimate the size themselves. This evidence, along with the concept of physical or conceptual vastness which characterizes awe, suggests that perceived scale may play a key role in eliciting awe experiences.

Subjective novelty is the third notable factor when considered in research on aesthetic experiences of awe. Keltner and Haidt (2003) describe novelty as a key component of awe experiences as it relates to the need for accommodation of existing mental schemas, and Fingerhut and Prinz (2018) draw a theoretical link between awe and interest through novelty as an eliciting variable. This is particularly important because despite the fact that awe may exist without appraisals of beauty or aesthetic liking (see Gordon et al., 2017; Ishizu & Zeki, 2014), the two are often associated in positive, non-threatening contexts (Keltner & Haidt, 2003; Konečni, 2005; Vessel et al., 2012). Despite extensive theoretical exploration of how novel stimuli may elicit awe (e.g. Armstrong & Detweiler-Bedell, 2008; Chirico & Yaden, 2018; Keltner &

Haidt, 2003; Konečni, 2005, 2015; Yaden et al., 2019), there has been very little direct empirical investigation of this relationship. One seminal piece of research in this area by Shiota and colleagues (2007), found that self-reported awe was elicited by novel art and music. These findings indicate that novel stimuli are more likely to elicit awe than familiar stimuli, and that some element of unfamiliarity may be advantageous – if not entirely necessary – in order to inspire awe experiences in the observer.

The three aesthetic factors discussed here – visual complexity, perceived scale, and subjective novelty – have all been shown to influence reported awe experiences, though the exact nature of their relationships with awe have yet to be fully explored. While the present study attempts to account for these elements in its stimulus selection based on the findings of prior research, we also seek to explore how these factors may influence awe experiences within the realm of expertise.

3.1.3 Physiological Measures of Awe

Awe as a complex emotional experience has become a growing source of interest in psychological research, especially as it pertains to aesthetics (e.g. Arcangeli, Sperduti, Jacquot, Piolino, & Dokic, 2020; Chirico, Clewis, Yaden, & Gaggioli, 2021; Chirico & Yaden, 2018; Clewis, 2021; Jabri, 2006; Keltner & Haidt, 2003; Konecni, 2005, 2015; Luke, 2021; Negami & Ellard, 2023; Quesnel & Riecke, 2018; Silvia et al., 2015; Smalley & White, 2023; Van Cappellen & Saroglou, 2012; Williams, Johnson, Bride, Baucom, & Crowell, 2022). Yet means of accurately measuring awe experiences can present a challenge for researchers, as the term is complex and may be difficult to evoke in a laboratory setting. One method of examining the physiological responses associated with awe is through measuring goosebumps, or 'chills', which are known to be associated with awe (Konecni, 2005). Quesnel and Riecke (2018) reported that participants who experienced

awe in response to VR settings also experienced a larger occurrence of goosebumps, which they measured using a camera apparatus. Schurtz and colleagues (2012) also found that goosebumps were highly correlated with awe experiences; in fact, awe was the second most frequently eliciting reason for goosebumps after reactions to cold environments.

Another means of objectively measuring awe experiences has been demonstrated through the use of electroencephalogram (EEG) studies which focus on electrical levels of brain activity that occur during aesthetic and affective experiences (Hu et al., 2017). For example, Gallagher and colleagues (2015) measure awe experiences during viewing of virtual reality scenes of outer space. In correlation with qualitative interviews, the researchers report associations between theta level decreases and self-reported instances of awe and wonder. Theta levels, which are associated with boredom and drowsiness, indicate a lack of attending to a stimulus; the lower levels of theta reported in individuals who did not report experiencing awe during the viewing, therefore, indicate the importance of attending to a stimulus in order to produce awe as an emotional response while also providing supporting evidence for EEG as a valuable measure of awe processes.

One means of potentially exploring awe experiences through objective physiological measures is by way of pupil dilation responses to stimuli. Pupil dilation is recognized as a valid measure of emotional arousal states (e.g. Bradley, Miccoli, Escrig, & Lang, 2008; Partala & Surakka, 2003) and cognitive processing (e.g. Aston-Jones & Cohen, 2005; Gilzenrat, Nieuwenhuis, Jepma, & Cohen, 2010). Regarding research in aesthetics, pupillometry methods have been previously utilised to record levels of interest (e.g. Carbon, Hutzler, & Minge, 2006) and pleasure (e.g. Kuchinke, Trapp, Jacobs, & Leder, 2009) when engaging in aesthetic experiences. One study reported pupil dilation differences during the identification and classification of objects in

paintings with varying levels of processing fluency (Kuchinke et al., 2009). The authors reported that pupil dilation increased immediately following explicit classification of an object within an artwork rated high in processing fluency, and that processing fluency was positively correlated with aesthetic preference. In other words, pupil dilation was associated with aesthetic emotions in response to higher processing fluency, which supports the role of pupil dilation as a measure of emotional responses to visual artworks.

At present, to the best of my knowledge, there is little evidence suggesting that pupil dilation may be utilised to objectively measure awe experiences. One recently-published study by Takano and Nomura (2023) reported frequent and significant changes in both pupil diameter and skin conductance responses (SCRs) when participants experienced awe. As the first study to examine fluctuation patterns in the sympathetic nervous system as they correlate with awe experiences, the implications of these findings suggest that pupil dilation may serve as a strong, objective indicator of awe which could be utilised alongside subjective reports. These results have not been generalized as of yet to the field of aesthetics. In consideration of how experts may differ from non-experts in both their reports of awe and their pupil dilation differences, it is important to continuously explore the use of pupil dilation as an effective measurement of awe experiences.

3.1.4 The Present Study

The purpose of the present experiment, therefore, was twofold: to examine whether pupil dilation could be utilized as a physiological representation of awe experiences, and to determine whether there are differences between individuals with experience in either the design or history of stained-glass and individuals with no experience in either area in how they aesthetically evaluated and emotionally responded to images of religious stained-glass windows. Based on prior research investigating the role of expertise in aesthetic judgments and

evaluations, we hypothesized that experts in stained-glass window design or history would report higher levels of aesthetic liking, denoting higher levels of appreciation, than non-experts. We also predicted, due to the success of prior investigations in utilizing physiological measures to examine awe experiences, that pupil dilation would correlate with self-reported awe responses across all participants.

Predictions regarding awe experiences as they relate to expertise are less clear, yet we can draw from explorations into other affective responses to aesthetics between experts and non-experts in order to inform our predictions. For example, Leder, Gerger, Brieber, and Schwartz (2014) report that expertise had a significant effect on their emotional responses to positively and negatively-valanced artworks. According to the researchers, participants who scored higher in expertise reported less intense emotional responses than those who scored lower in expertise. These results are countered in a neuroimaging investigation by Else, Ellis, and Orme (2015), who report that while experts reported similar emotional responses to non-experts, event-related potentials relating to attention, visual processing, and emotional arousal were greater in experts in comparison to non-experts, especially when viewing abstract art. The relationship between affective responses and expertise, therefore, appears to be a complex one with relations to content as well as formal features. In the context of the present study, we hypothesize that experts will report more intense experiences of awe, and that this will be reflected in pupil dilation differences between the two groups.

Finally, in our investigation into the predictive ability of pupillometry in awe experiences, we hypothesized that differences in pupil dilation would be positively correlated with self-reported awe in response to stained-glass window stimuli. As reported in Section 3.1.3, other physiological measures – such as EEG, fMRI, and measures of heart rate and SCRs – have been successfully validated as responses to

awe experiences. Pupil dilation as a response to awe-eliciting stimuli has yet to be explored, however. Prior research incorporating other physiological measures of awe provide evidence which aids us in our predictions that pupil sizes will correlate with awe reports; that is, when a participant reports that they experienced awe, this will be associated with an increase in pupil size.

3.2 METHODS

3.2.1 Participants

40 participants (31 female, 9 male, ages 19 - 71, M = 38.8, SD = 17.7) were recruited from around the Dublin area, particularly from Trinity College Dublin, the National College of Art and Design, and various stained-glass window workshops and interest groups stationed around the city. 36 of these participants reported that they had completed at least their third-level education, while the remaining 4 reported that they had completed secondary level. Of all participants, 20 were recruited as experts in stained-glass window history or design and 20 were recruited as non-expert participants with no prior history. Participants also gave self-reports of whether they considered themselves to be religious: 11 reported 'yes', 26 reported 'no', and the remaining 3 preferred not to respond.

In order to avoid potential risks involved with the experimental procedure, participants were screened for photosensitive neurological disorders – such as epilepsy – and optic-sensitive migraines. Participants were also screened for colour blindness and normal or corrected-to-normal vision using unifocal lenses or contacts in order to ensure accuracy of the eye tracker and validation of the results. All participants gave their consent prior to attending an in-person experimental session. Following their completion of the experiment, participants were compensated with either a digital National Book Token voucher or – as an option for Trinity College Dublin staff and students – credit on their student card. All participants received compensation worth €5 for completing the study, and an additional €5 in compensation value was given to participants from outside Trinity College Dublin, where the study took place, to compensate for travel costs.

3.2.2 Design

The present study incorporated a one factor between-subjects experimental design where expertise served as the primary independent variable and awe, aesthetic liking, and pupil sizes were the primary dependent variables. Participants were divided into two groups – 'experts' and 'non-experts' – based on targeted recruitment and their reported prior history with stained-glass windows. Visual complexity was also considered as a potential secondary variable influencing awe and aesthetic liking ratings of stained-glass window stimuli. The stimuli and following statements were randomly ordered during the procedures of the experiment; only the awe question was not randomly ordered, but was instead consistently presented following the preview stage of each stimulus image and without an accompanying smaller version of the image. This was done in order to gather the closest initial reaction as possible from participants.

3.2.3 Stimuli & Apparatus

The stimuli utilised in the present study were drawn from the experimental sample outlined in Chapter 2. In order to minimize potential subjective familiarity biases, only stimuli which scored the lowest on familiarity ratings were chosen to be utilised in this study. With the addition of the fourteen 'supplemental' images which were included in the low-complexity category, 22 stimulus images were incorporated into the present study procedures. All images were matched for luminance using the MATLAB SHINE toolbox (R2023a) in order to ensure differences in brightness would not influence pupil dilation patterns.

The experiment was presented in a dark room on a 349mm (height) x 615mm (width) desktop screen with a 1920 x 1080 resolution, and participants were seated 520 mm away with their faces positioned in a headrest (see Figure 3A). The visual angle was calculated as 10°.

Figure 3-1: Eye tracker apparatus set up in the testing lab. Participants were seated with their heads placed in the headrest for stability throughout the course of the experiment. The Tobii Pro Fusion eye tracker was placed at the bottom of the monitor screen to record during testing.

3.2.4 Procedure

Before attending an in-person session, participants were requested to complete a short online preliminary survey hosted on the open-source experiment portal Pavlovia. The survey consisted of the experiment consent form, a demographic section, and two pre-screening surveys: the awe-related items of the Dispositional Positive Emotion Scale (DPES; Shiota et al., 2006) and an edited form of the Art Experience Questionnaire (AEQ; Chatterjee et al., 2010), which was slightly altered to include questions related to stained-glass window

expertise rather than general art experience. The DPES scale contains 6 items relating to the individual's openness and ability to experience awe, while the AEQ contains 8 items pertaining to an individual's expertise scores. Differences in responses were assessed and compared following data collection.

Following completion of the online survey, participants were invited to attend an in-person session in the basement of the Lloyd Institute at Trinity College Dublin. Participants were instructed to restrict their caffeine intake 3 hours before the experiment appointment in accordance with prior research citing the influence of caffeine on pupil dilation patterns (Abokyi, Owusu-Mensah, & Osei, 2017; Murari, Ho, Hayes, & Cooper, 2018). Experiments took place in a dark room in the Multisensory Perception and Cognition testing lab, where participants were instructed to rest their chins on a headrest that had been set up and positioned prior to their arrival. Participants could adjust the height of the chair they were seated in for their comfort.

On the onset of the experiment, participants were instructed to complete two brief calibration and validation tasks for the Tobii Pro Fusion eye tracker, which consisted of a pulsating green dot moving around the computer screen to nine different points. Participants were instructed to follow the dot as it moved across the screen with their eyes without moving their heads in order to first calibrate, and then validate, the eye tracker for the experiment. Once this task was completed, participants were instructed to complete two practice trials, which were meant to simulate the procedures of the actual experiment. The eye tracker did not record pupil dilation changes during these practice trials.

Each participant experienced 22 experimental trials, and each trial consisted of two parts: the pupil dilation recording and the behavioral scales. The first part of each trial consisted of a ten-second view sequence of each stained-glass window image, during which time pupil dilation changes were recorded. This viewing sequence consisted of four

stages: a one-second fixation cross presented on the screen to draw the participant's attention, a two-second blank screen to gather baseline data, a five-second view of the image itself wherein participants could move their gaze around the screen and focus on any given detail, and another two-second blank screen for a return to baseline.

Following each image viewing sequence, the participants were administered a series of statements to respond to on a seven-point Likert scale, including statements pertaining to perceived scale, familiarity with the window itself, liking, beauty, and awe (see Table 3.1). All statements were administered in a randomized order for each trial, and all statements were paired with a smaller version of the stimulus image for reference, except for the awe-related question. In order to record participants' initial reactions and preserve the effects of novelty for each image, the awe question was always presented first and was always presented without an accompanying version of the image. The experimenter was also not present in the room during the experimental trials in order to avoid unnecessary distractions or accidental influence of the answers.

Following the completion of all 22 trials, participants alerted the experimenter of their completion, received a verbal and written debriefing of the study's intentions and procedures, and were thanked for their time.

INDEX	QUESTION/STATEMENT
1	When you viewed the previous image, did you experience awe?
2	I like this image.
3	I find this image to be beautiful.
4	I am familiar with this image.
5	I think this image is larger than the average person.

Table 3-1: Trial questions presented to participants following the viewing of each stimulus. All questions were presented in a random order save for the awe question, which was always presented first in order to gather as initial of a reaction as possible.

3.2.5 Data Analysis and Pupillometry Pre-Processing

Following data collection, pupil data were transferred from the original HDF5 file they were recorded in to a Microsoft Excel file for easy cleaning. The data was then manually organized into distinctions of trials for each individual participant, including trial times, unique stimulus IDs, and trial numbers. Following this, pupil data were pre-processed according to the procedures laid out by Forbes (2020), using the R package PupillometryR. Before analyses were conducted, data was smoothed, interpolated, and baseline-corrected in order to remove the effects of blinks, errors, and missing data while also controlling for natural differences in pupil size between individuals. The expected trends for pupillometry patterns based on the procedures conducted are presented as a mock-up in Figure 3-2, while the actual resulting baseline-corrected data points, separated by participant ID, are illustrated in Figure 3-3.

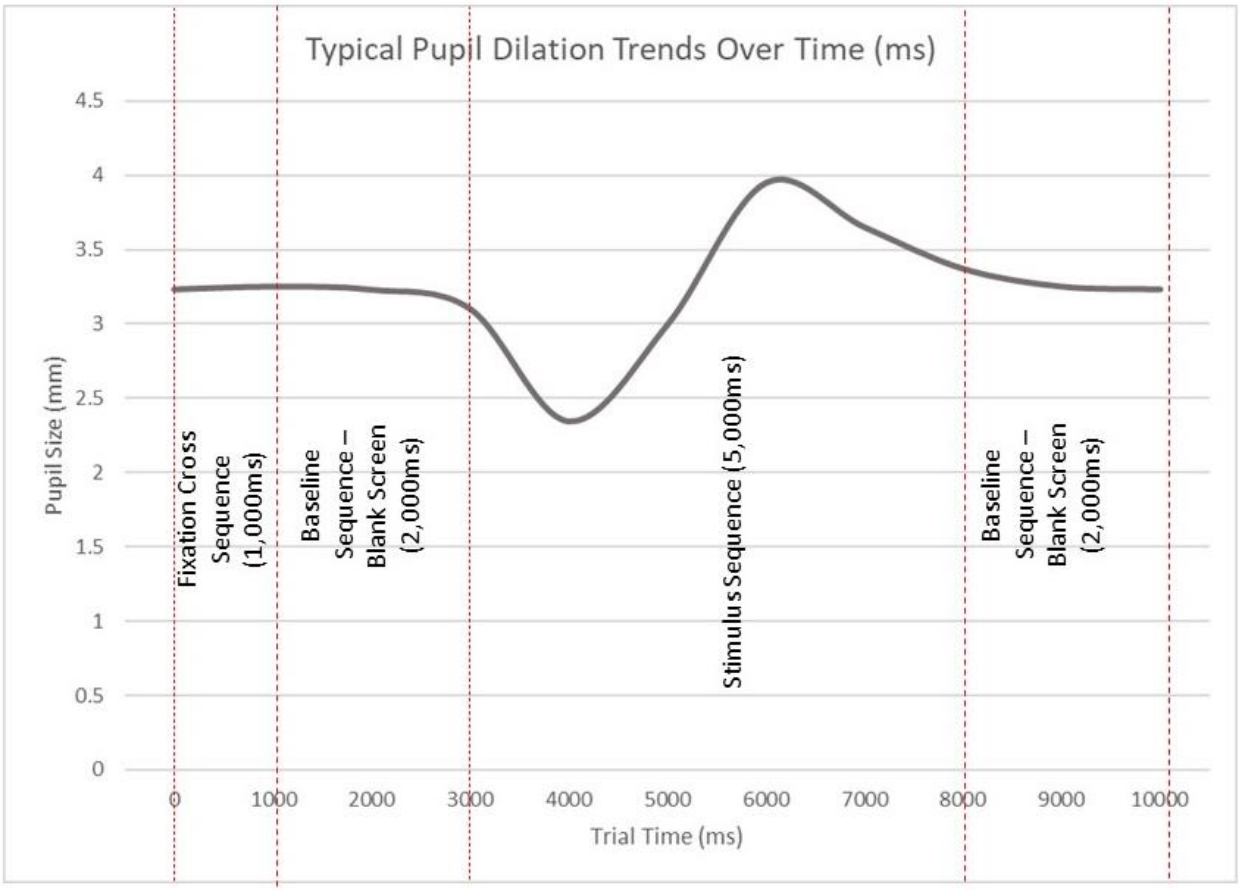

Figure 3-2: Mock-up of expected pupillometry trends in data. Time bins are marked for baseline periods and stimulus onset – note the sharp decrease representing initial stimulus onset, followed by an increase in pupil size as the stimulus remains on the screen and eventually a return to baseline.

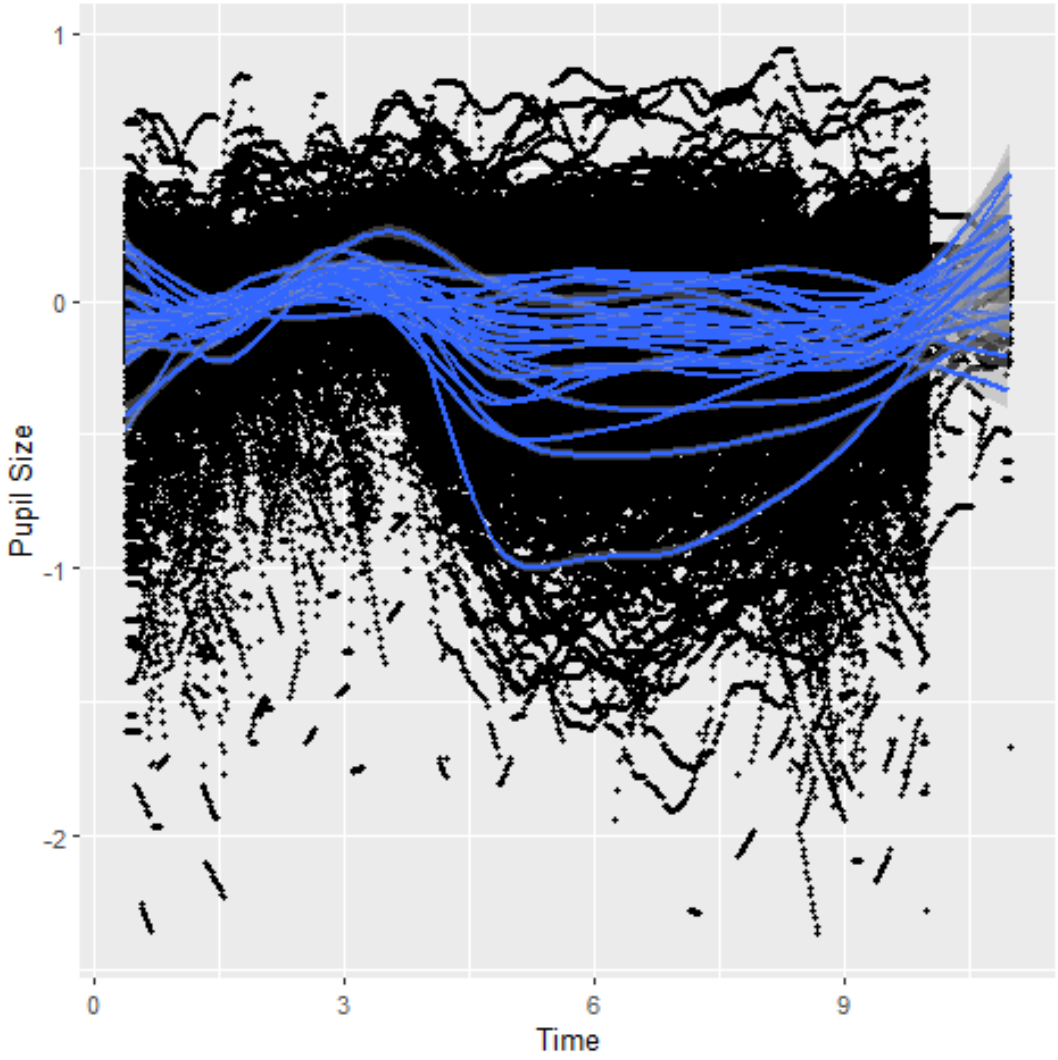

Figure 3-3: Scatterplot of pupillometry data grouped by participant ID, with accompanying trend lines. The black indicates individual participant readings for every trial after data has been baseline-corrected, and the blue lines indicate the average trend for each participant across all trials.

3.3 RESULTS

Due to unforeseen technical errors, the pupillometry data from 11 participants were not recorded. These participants were therefore excluded from all pupillometry analyses, but were included in analyses regarding behavioral data. One further participant was excluded due to a loss of both pupillometry and behavioral data, leaving 28 participants (11 experts, 17 non-experts) of the total 40 recruited to be considered in pupillometry analyses and 39 of the total 40 (19 experts, 20 non-experts) to be considered in behavioral analyses.

First, we examined responses to the DPES Awe scale, which we utilised to examine differences between expertise groups in disposition to experience awe (see Figure 3-4). Disposition for awe experiences ($M = 5.254$, $SD = 0.759$) was normally distributed according to a Shapiro-Wilk test, $W = 0.976$, $p = 0.538$, had a nearly symmetrical skew of -0.173, and was slightly playkurtic at a value of 2.704. An independent sample t-test conducted showed a significant difference between expertise groups, $t = 2.391$, $p = 0.022$, wherein experts reported a larger disposition to experiencing awe ($M = 5.525$, $SD = 0.687$) than non-experts ($M = 4.983$, $SD = 0.745$).

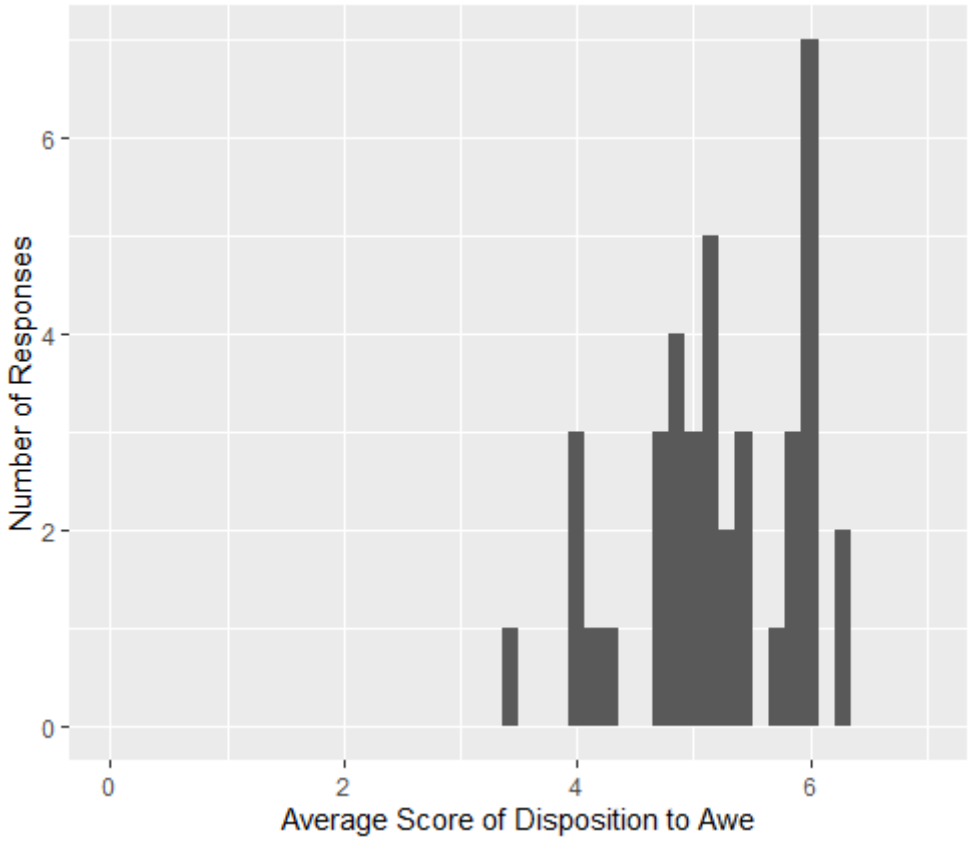

Figure 3-4: Distribution of Disposition for Positive Effects Awe scale (Shiota et al., 2006). Experts in stained-glass windows reported to be significantly different in comparison to non-experts in their disposition to experiencing awe.

Next, we examined differences in the scores given for the AEQ (Chatterjee et al., 2010; see Figure 3-5). Overall scores on the AEQ ($M = 12.800$, $SD = 10.059$) were not normally distributed, $W = 0.892$, $p < 0.01$. The data was positively skewed at 0.978 and was slightly platykurtic at 2.970. A Wilcoxon rank test revealed a significant difference between expertise groups in AEQ scores, $W = 369.5$, $p < 0.01$, with experts ($M = 19.650$, $SD = 9.938$) scoring significantly higher than non-experts ($M = 5.950$, $SD = 3.187$). It should be noted, however, that several non-experts reported higher scores than some experts, indicating a potential issue of validity when applying this scale to stained-glass windows.

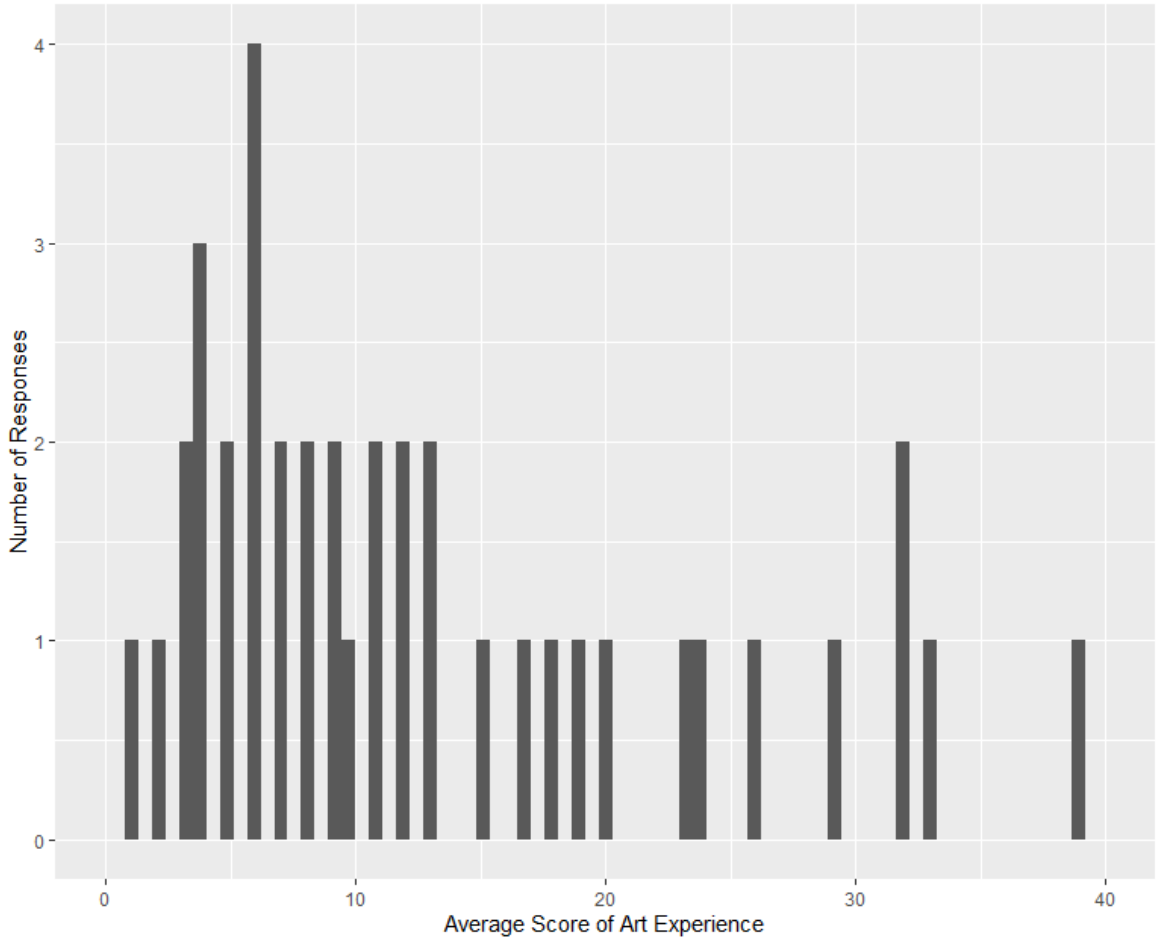

Figure 3-5: Distribution of Art Experience scores. Scores were not normally distributed and were significantly different between expertise groups, with experts scoring, on average, significantly higher in total than non-experts.

3.3.1 Pupil Dilation Differences and Associations with Awe

Pupillometry data was preprocessed for analyses according to the procedures outlined in Section 3.2.5. An independent t-test was conducted on baseline data to determine if there was any significant difference between experts and non-experts in pupil baseline size. Group baselines were not significantly different, $t = 0.194$, $p = 0.848$, CI 95% [-0.376,0.453]. Then, a paired samples t-test was conducted to compare pupil size averages between baseline time and stimulus onset to validate the procedures of the experiment. The differences were statistically significant, $t = 4.249$, $p < 0.01$, CI 95% [0.070, 0.201], with a mean difference of $M = 0.136$.

We then conducted an independent samples t-test comparing changes in pupil size during stimulus onset between the two expertise groups. Group averages were statistically significant, t = 1.204, p = 0.01, CI 95% [0.024, 0.164], where non-experts (M = -0.125, SD = 0.119) recorded larger changes in pupil size than experts (M = -0.031, SD = 0.058; see Figure 3-6).

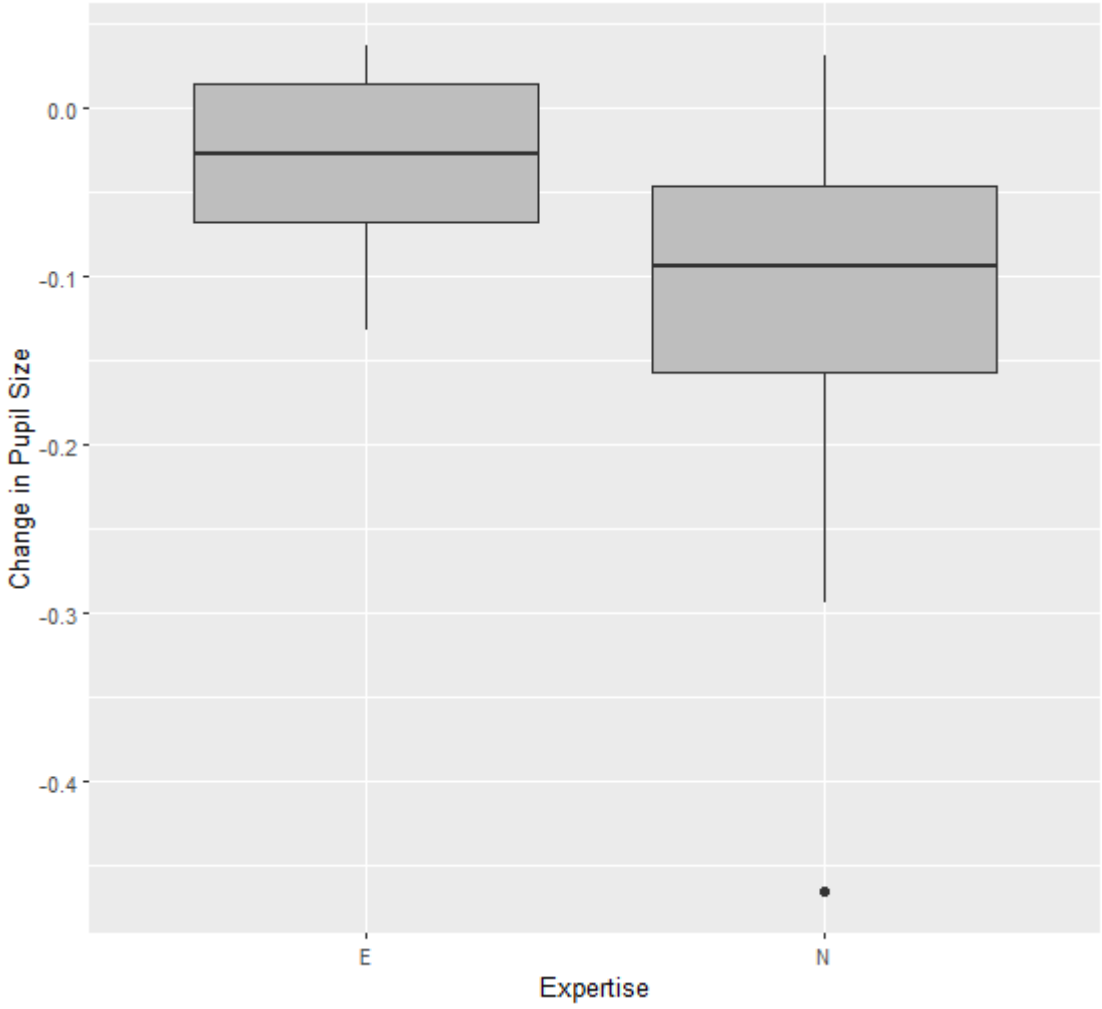

Figure 3-6: Differences in pupil size differences between expert and non-expert participants. Non-experts experienced significantly greater changes in pupil dilation in comparison to experts.

Finally, following these analyses, we examined the correlation between self-reported awe experiences and pupil dilation. Averages of awe experiences and averages of pupil dilation per participant were significantly positively correlated, r(26) = 0.379, p = 0.047, CI 95% [0.007, 0.659]. This is illustrated in Figure 3-7.

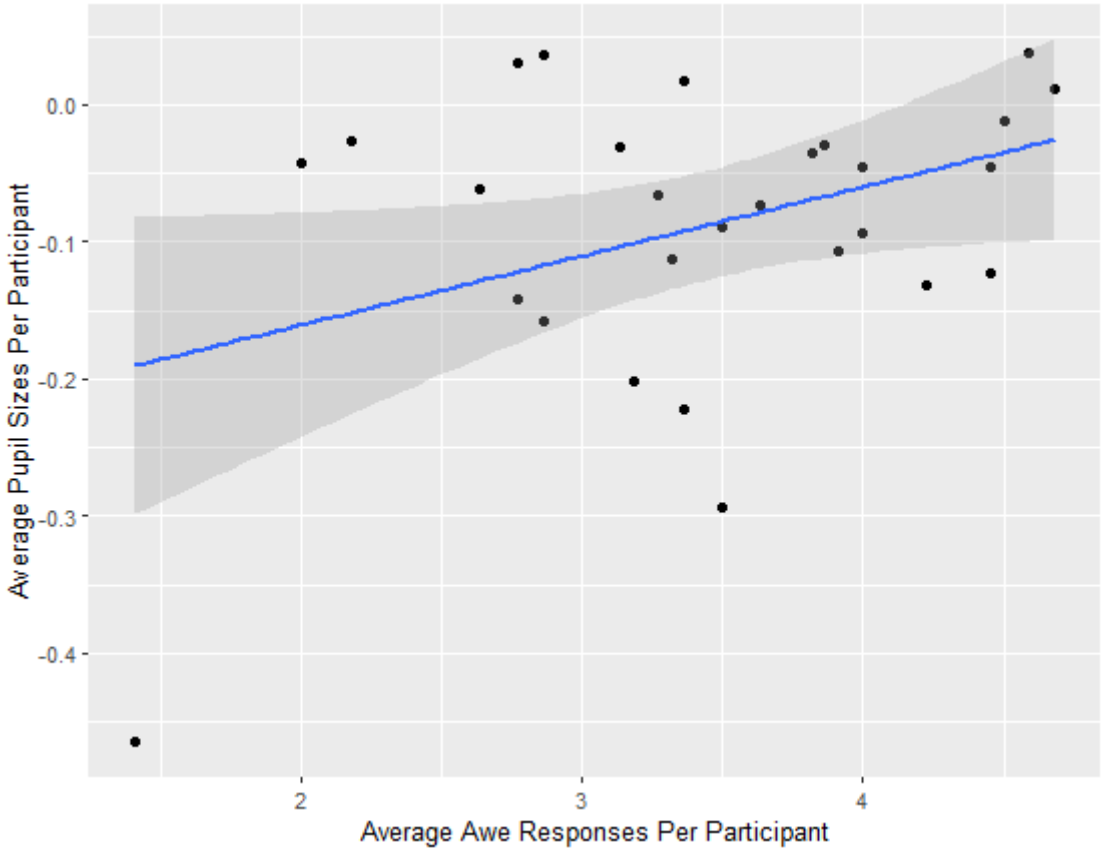

Figure 3-7: The linear relationship between recorded awe responses and pupil dilation per participant. The data is significantly positively correlated.

3.3.2 Awe, Aesthetic Liking, and the Influence of Expertise

Before conducting our main analyses, we conducted a multiple linear regression to determine whether familiarity and perceived scale – both on their own and in combination with each other – significantly predicted awe responses. The fitted regression model was: Awe Responses = 0.265 + 0.416 (ratings of familiarity) + 0.400 (ratings of perceived scale). Ratings of familiarity significantly predicted awe

ratings on its own, $R^2 = 0.341$, $F(1, 20) = 11.88$, $p < 0.01$, as did perceived scale, $R^2 = 0.461$, $F(1, 20) = 18.93$, $p < 0.01$. In combination with each other, both variables significantly predicted awe, $R^2 = 0.543$, $F(2, 19) = 11.29$, $p < 0.01$, indicating a strong influence both on their own and in combination in eliciting awe experiences.

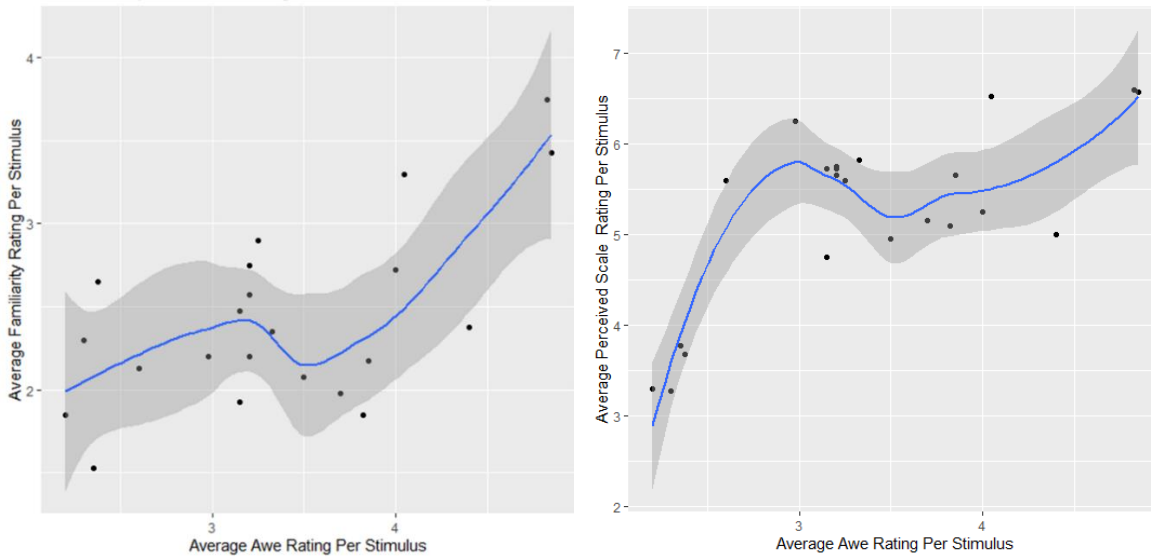

Figure 3-8: Linear regression illustrations of familiarity (left) and perceived scale (right) as they predict awe.

In order to explore the differences between experts and non-experts in reports of awe when viewing stained-glass windows, we conducted an independent samples t-test on their responses to the awe Likert scale. The results of this t-test are illustrated in Figure 3-9. The differences in reported awe experiences between experts ($M = 3.660$, $SD = 0.870$) and non-experts ($M = 3.14$, $SD = 0.821$) were not significant, $t = 1.931$, $p = 0.061$, CI 95% [-0.026, 1.074], with a medium effect size, $d = 0.619$. Awe was normally distributed, both overall ($W = 0.970$, $p = 0.364$) and across both groups, experts $W = 0.960$, $p = 0.560$ and non-experts $W = 0.929$, $p = 0.148$.

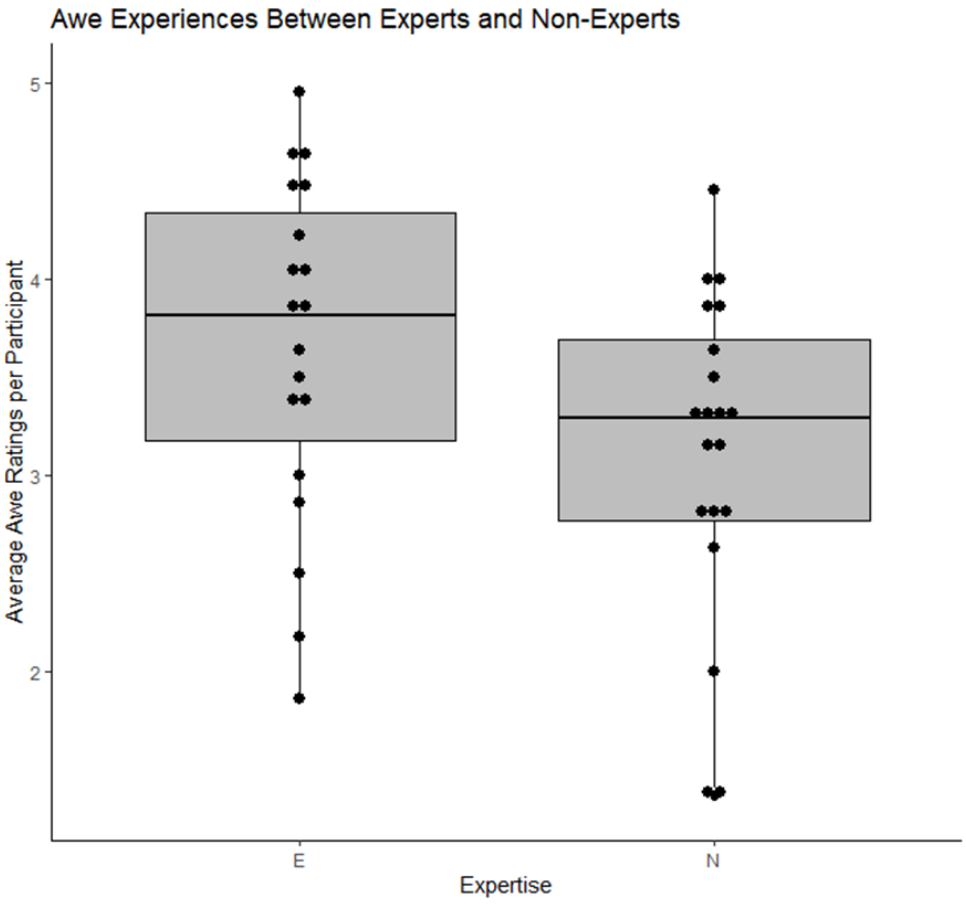

Figure 3-9: Differences between expertise groups in awe responses. The responses were not statistically different according to analysis from an independent samples t-test.

Finally, we examined differences in expertise groups when it comes to differences in components of aesthetic liking – namely, liking and beauty. On average, experts scored higher in liking (M = 5.12, SD = 0.554) and ratings of beauty (M = 5.12, SD = 0.636) than nonexperts (liking M = 4.71, SD = 0.627; beauty M = 4.87, SD = 0.594). We then conducted an independent samples t-test in order to further examine these differences between the groups in liking and beauty ratings. The results showed significant differences in ratings of liking, t = 2.180, p = 0.036, CI 95% [0.029, 0.799], but not beauty, t = 1.307, p = 0.199, CI 95% [-0.142, 0.656]. These results are illustrated in Figure 3-10.

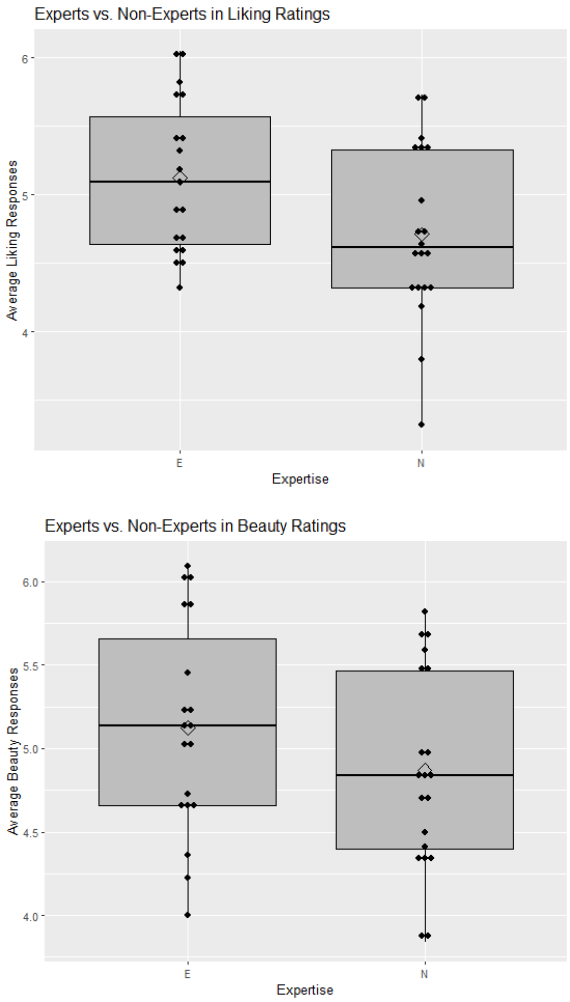

Figure 3-10: Comparisons between expertise groups in ratings of liking (left) and beauty (right). Differences between groups were significant for liking only.

3.3.3 Complexity in the Aesthetic Experience

In order to shed light on the relationship between visual complexity and aesthetic liking as it relates to stained-glass windows, we compared responses to high-complexity versus low-complexity images. We first examined the role of complexity on awe responses using an independent samples t-test. Awe responses to high-complex images (M = 3.743, SD = 0.706) were found to be significantly higher than awe responses to low-complex images (M = 3.009, SD = 0.658), t = 2.522, p = 0.020, CI 95% [0.127, 1.341]. These results are illustrated in Figure 3-11.

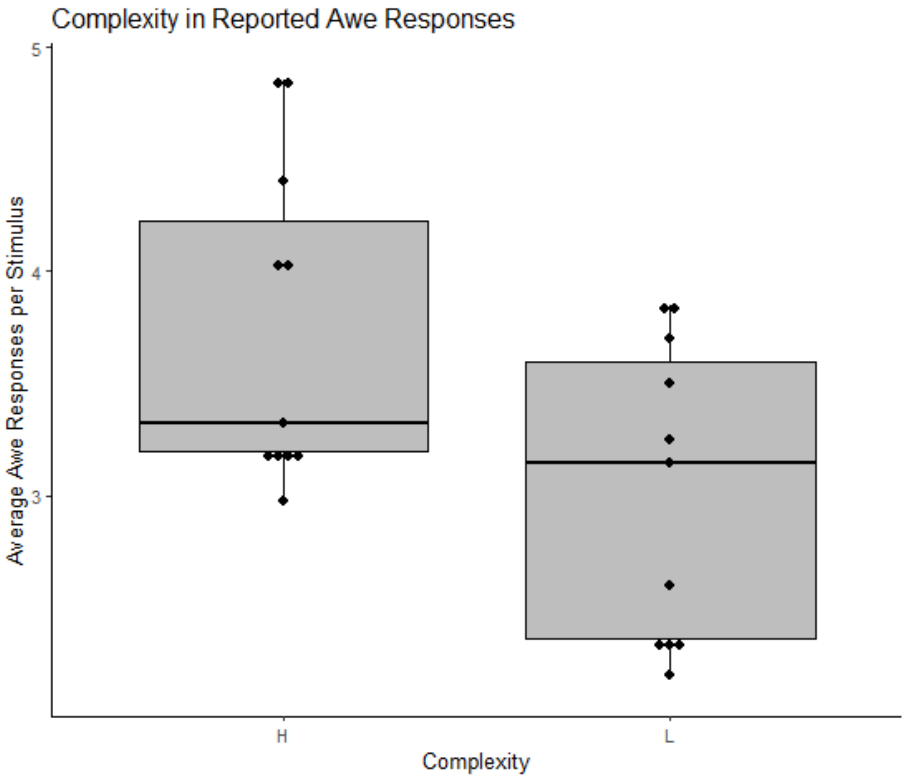

Figure 3-11: Differences in awe responses between high complex (H) and low complex (L) stimuli. The differences were significant based on an independent-samples t-test.

We also conducted an independent samples t-test considering differences in liking and beauty ratings based on complexity differences. Significant differences were found between both variables: high complex images were also liked more (M = 5.216, SD = 0.645) than low complex images (M = 4.552, SD = 0.813), t = 2.122, p = 0.047, CI 95% [0.009, 1.318]. They were also significantly rated as more beautiful (M = 5.361, SD = 0.610) than low complex images (M = 4.566, SD = 0.819), t = 2.584, p = 0.018, CI 95% [0.150, 1.441]. These differences are both illustrated in Figure 3-12.

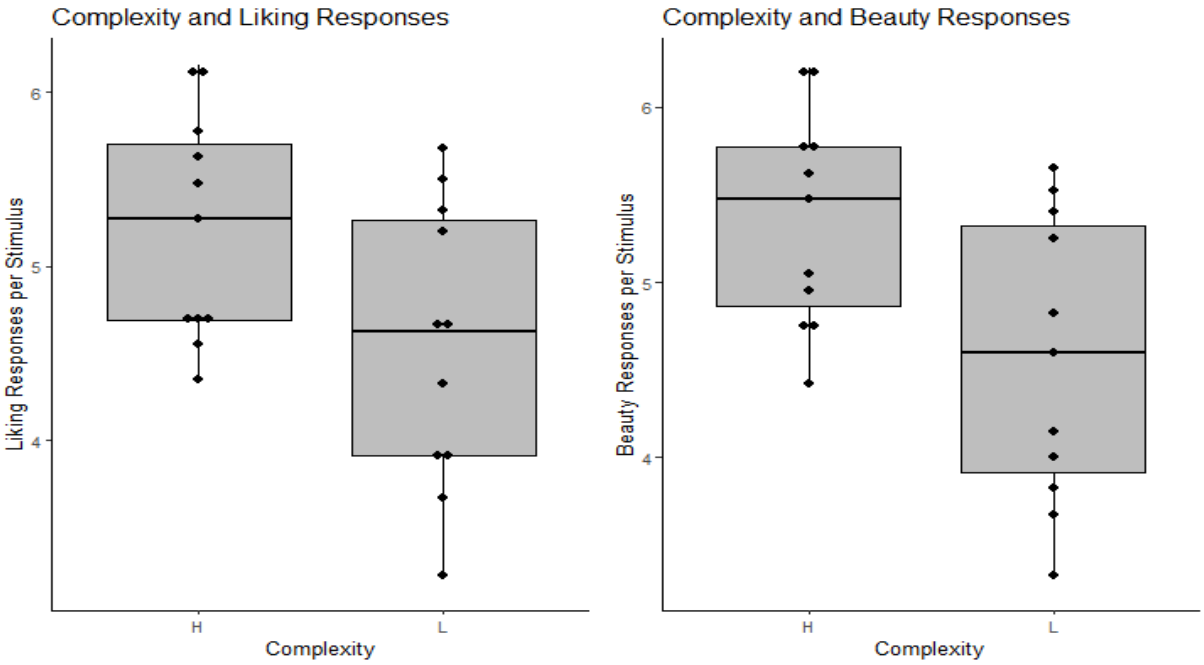

Figure 3-12: Differences in ratings of liking and beauty based on the level of visual complexity of the stimulus. Differences were significant for both variables, with high-complexity stimuli being more liked and rated as more beautiful than low-complexity stimuli.

3.4 DISCUSSION

The purpose of the present study was to examine how expertise in stained-glass window design or history may influence the way viewers judge and respond to images of religious stained-glass windows. In the field of aesthetics, expertise and its role in aesthetic judgments and responses are common topics of interest due to the role of prior experience and knowledge on category familiarity and appraisals (Leder et al., 2004; 2014; Silvia, 2005). The present study considers how this factor may play a part in the evaluation of stained-glass windows, particularly in relation to awe as an aesthetic emotion and pupil dilation as a physiological representation of awe.

The results of this investigation started off by considering how aesthetic features such as perceived scale and novelty influence responses to awe. As expected, perceived scale was positively correlated with awe experiences, though these results followed a sharper incline than was previously expected and appeared to plateau and even begin to decline at a certain point in scale ratings before eventually increasing once again (see Figure 3-8). This trend may indicate something of a threshold effect, wherein the perceived size of an object may actually decrease awe experiences if it is perceived as large but not overwhelming. This relates to the effects of awe creating a small 'sense of self' in comparison to the experience being viewed: if the observer does not experience that small-self impact during viewing while still acknowledging that the object in front of them is perceptively large, this may impact the sense of awe drawn from the experience (Bai et al., 2017; Piff et al., 2015; Preston & Shin, 2017). Future research into the effects of scale on awe experiences may seek to consider the full impact of scale alone in eliciting awe, as well as how it relates to other factors and creates that sense of the small self.

Surprisingly, positive ratings of familiarity also predicted positive awe ratings, indicating that the more familiar the stimulus was, the more

likely it was to elicit awe. While also lending some explanation to the results found between experts and non-experts in awe experiences, these findings suggest that the novelty of a stimulus may not be as important to eliciting awe as was previously surmised. It also may provide evidence to support the role of a 'prototypical' model of familiarity in aesthetic perception: Hekkert, Snelders, and van Wieringen (2003) show that elements of both novelty and typicality – i.e. how typical an object's features are perceived to be in relation to other examples of its category – are significant influences on aesthetic perception, especially considering the influence of expertise in the subject category. While the present study does not consider the associations with familiarity and aesthetic perception directly as it relates to expertise, future research into the role of expertise on awe experiences may consider how familiarity with certain examples within a category may play into the prototypical model and inform emotional responses to aesthetics.

Regarding the pupillometry evidence, while significant differences between expertise were found when investigating pupil size differences, very little evidence was produced to support pupillometry as an effective physiological measure for awe. This is contrary to evidence provided in a recently-published article by Takano and Nomura (2023), wherein the authors report that awe experiences led to greater frequencies in fluctuations of pupil dilation. It should be noted, however, that while the pupillometry task in the present study was passive – i.e. participants were only instructed to view the images during the pupil measurement phases of the experiment – Takano and Nomura's experiment contained an active element where participants were required to make choices while their pupils were being measured. The cognitive processes underlying decision making are known to influence pupil size (Simpson & Hale, 1969), and so it is possible that the active element of the task also had an influence on pupil dilation which could explain their findings

in contrast with the present study. In light of this, our findings suggest that while pupillometry may serve as an objective indicator of awe experiences, the methodology which is applied in such situations must be highly controlled for other influences – such as decision-making processes – and should be further explored in order to generalize its use.

The behavioural data collected in this investigation, though not statistically significant, suggests a potential influence of expertise on the aesthetic judgments of stained-glass windows, particularly when it comes to aesthetic awe experiences. As Silvia and colleagues (2015) argue, the influence of expertise on awe experiences is not as clear-cut as it is when considering aesthetic pleasure because awe is both characterized by complex, information-rich stimuli and a need to mentally accommodate a new experience. As experts possess a broader understanding of the subject they are knowledgeable about, it is not immediately clear whether they would experience awe more or less frequently than non-experts because they both possess greater insights into what they are experiencing and are less susceptible to a violation of their expectations (Silvia & Berg, 2011). This investigation serves as one of the first explorations into how prior knowledge and experience in an aesthetic subject can facilitate awe experiences rather than hinder them: while the differences were not significant, there was still a clear difference between experts and non-experts in reports of awe when viewing stained-glass windows. Notably, experts significantly differed from non-experts in their disposition to experience awe, which may explain some of the difference in reported experiences. These results may become more robust with a larger sample size or different methodology in future investigations exploring the relationship further, but this marks an initial step into the role of expertise in complex emotional responses such as awe.

Finally, the present study also sought to provide further evidence to illustrate the relationship between visual complexity of an artwork and aesthetic liking. As has been mentioned above, the relationship between visual complexity and aesthetic perception and responses is not well-understood. Though empirical evidence has shown that there is some kind of relationship between the two factors, the nature of this relationship is as yet unclear. Our findings suggest a more linear relationship wherein images which higher visual complexity are liked more, thought to be more beautiful, and elicit more intense responses of awe than images of lower visual complexity. These findings deviate from the well-known model of an inverted-U curve (Berlyne, 1970, 1971) and are instead in line with the findings of Osborne and Farley (1970), who reported a general preference for highly complex abstract artworks when given the options between low, moderate, and high complexity. Nadal and colleagues (2010) suggest that discrepancies in results related to visual complexity may derive from different facets of complexity, such as symmetry and organization, which are represented and assessed differently according to the viewers' own preferences. In addition, Güçlütürk, Jacobs, and van Lier (2016) find a strong influence of individual differences on the relationship between complexity and aesthetic liking, suggesting that preferences for complexity may be more individualized than previously examined. These results indicate that, while we report a positive relationship between complexity levels and aesthetic preference, the interaction between aesthetic elements and liking may be more complex and multifaceted than was considered here, especially as it relates to individual differences and unique forms of aesthetics such as stained-glass windows.

3.4.1 Limitations and Implications for Future Research

There were several limitations involved in this study which must be considered in future research designs. First, in order to control the context in which these windows were viewed, the stimuli were presented

in a lab setting on a desktop computer. This means that the images of windows were presented without essential contextual information about the placement, position, size, and environment they are featured in. These contextual factors are known to play a role both in eliciting awe experiences (Seidel & Prinz, 2018; Shiota et al., 2007) and aesthetic perception (Swami, 2013). While the present design allowed for the researchers to control for influences of light variation and external factors which may have interfered in the pupillometry readings, it also neglected the ecological validity of the context in which stained-glass windows – especially religious ones – are often viewed. Furthermore, part of the aesthetic value of the windows themselves is their kinaesthetic interactions with light; it is what makes them an entirely different art form from paintings, sculptures, and other visual art pieces, and this effect may not be as easily captured on a two-dimensional computer screen. Future research, therefore, may consider other methods of examining emotional and physiological responses to stained-glass windows while also taking into account the context of their surroundings and the expected function of their role as glass pieces, such as field research or virtual reality.

Second, the present study was underpowered in its sample, and therefore any effects observed – either significant or not significant – may not represent the full nature of the relationships at play. A sufficient sample for this study was determined early on to be 52 participants in order to achieve a large effect size ($d = 0.8$). The present study was underpowered with only 40 participants in recruitment; this was further complicated by the loss of 11 participants' pupillometry data and one further participant's pupillometry and behavioral data. Therefore, while some significant effects are reported here – such as the influence of expertise on aesthetic liking and the influence of complexity on liking, awe, and beauty – future research needs to consider a larger sample of participants in order to fully understand the true nature of these

relationships. This is especially the case where significant relationships were not found, such as in the interaction between expertise and awe, but were so close to being significant that a larger sample may have yielded different results.

Third, complexity as a variable was only considered in the present study as a two-level factor, consisting of either 'high' or 'low' visual complexity. As discussed in Chapter 2, the prevailing theory of visual complexity posits an inverted-U curve, wherein when a certain threshold of complexity is met, aesthetic appreciation begins to decrease (Berlyne, 1970, 1971). Complexity was not considered as the main focus for this investigation; however, the present findings suggest a more linear relationship exists in relation to both awe experiences and aesthetic liking of stained-glass windows. Future research may seek to explore this relationship with a focus on intermediate complex images in order to examine visual complexity trends with more clarity.

Finally, because the vast majority of participants reported as not religious (n = 26), religiosity as a potential covariate of expertise could not be explored. Qualitative feedback from participants, however, reported that some individuals in both expertise groups had based some of their evaluations on the content rather than the formal components when it came to the religious themes and subjects of the works depicted. Members of both expertise groups verbally and informally reported a preference for non-religious windows or windows which contained fewer religious symbols and themes, indicating the possibility of content overwhelming the typical top-down cognitive-affective processing which would occur in experts. Such a phenomenon would require further exploration, especially as very little research has been conducted examining how experts respond to religious aesthetic objects.

On a similar note, the present sample of stimuli was predominantly representational in nature, only containing a few abstract images. As stated in Section 3.1.1, expertise has been extensively examined in

relation to perceptions of abstract versus representational art, with many investigations finding that experts appreciate and understand abstract art more than non-experts do (e.g. Bimler, Snellock, & Paramel, 2019; Darda & Cross, 2022; Furnham & Walker, 2001; Leder et al., 2012; Marković, 2011; Pihko et al., 2011; Silvia, 2013; Van Paasschen, Bacci, & Melcher, 2015). In consideration of the potential influence of religious themes, future studies should also consider how abstract stained-glass windows may provoke different emotional responses and aesthetic judgments in experts versus non-experts of stained-glass window design and history. In doing so, researchers would be exploring the possible generalizability of expert effects while also shedding some light on the aesthetic potential of stained-glass windows as an artistic medium and topic of research.

3.5 CONCLUSIONS

The role of expertise in aesthetic appreciation and judgment is a reoccurring point of discussion for researchers interested in how cognitive-affective processes of perceiving art and artistic objects differ between individuals. Previous explorations of expertise have examined how experts interpret and respond to different kinds of visual art, mainly paintings, and how their prior experiences and ability to associate an example of an artwork with their knowledge of formal and historical elements leads to an increased appreciation for art – especially abstract art – within their field of reference. The present study considered not only how expertise may affect the aesthetic appreciation of stained-glass windows, but also how experts may differ from non-experts in their experiences of awe and how those differences may be illustrated through means of pupil dilation. The results of this study provide evidence to support the generalizable effects of expertise on stained-glass windows as an aesthetic medium. It also illustrates some of the first evidence towards the effects of expertise on physiological and self-report measures aesthetic awe experiences and further emphasizes the role of visual complexity on aesthetic judgment. While several limitations exist which future research procedures should take into account, this experiment presents several initial findings which may further our understanding of how expertise influences our perception of aesthetic objects in our environment.

CHAPTER 4: LIGHT VARIATION AND CHRISTIAN RELIGIOSITY AS FACTORS OF APPRECIATION: AN ONLINE INVESTIGATION OF AESTHETIC JUDGMENT AND RELIGIOUS STAINED-GLASS WINDOWS

4.1 INTRODUCTION

Stained-glass windows as an aesthetic medium are historically and symbolically rooted in religious – particularly, Christian – themes and symbolism. As is briefly discussed in Chapter 1, stained-glass windows have served a function of transmitting light into holy and sacred spaces for centuries, with the symbolism of the light of the Divine emphasized in its design (Rosewell, 2012). They serve as part of what makes the space of the building they are in – often a church or chapel – a spiritual experience (Ramos, 2015). As such, two essential factors of stained-glass windows are considered in this chapter: their value as religious artistic objects, and their inseparable relationship with light as a part of their aesthetic experience.

4.1.1 Religiosity as an Individual Influence of Aesthetic Appreciation

The relationship between religion and art is a complex, multifaceted one which has been examined in various contexts related to aesthetics, including non-art related aesthetic experiences. As a top-down processing factor which may guide the observer's aesthetic preferences towards one or another aesthetic feature, religiosity has been noted by art historians, philosophers, and theologians as not only a source of inspiration for artists, but also a vehicle for interpretation of artworks throughout various time periods and within different cultural regions (e.g. Adorno, 1945; Conlin, 2003; Martland, 1966; Mortensen, 1994; Shusterman, 2008). Bullot and Reber (2013) report the influence

of religion as a factor of historical context on the psychological and emotional responses to how artworks are perceived. Their psycho-historical approach to art appreciation addresses how understanding context can expand upon the aesthetic experience and appreciation of an artistic object, though their focus is on other historical elements beyond religion alone.

When it comes to religion, notably, most approaches to studying this connection between visual art and religious beliefs have taken the perspective of how aesthetic experiences influence religious, spiritual, and moral ideas and behaviors. For example, one approach recently proposed by Callaway, Rowatt, Al-Kire, and Schnitker (2023), for example, attempts to address religious and spiritual cognitive-affective process as they relate to aesthetic experiences. In their approach, the authors discuss the religious-aesthetic relationship from the basis that art and artistic stimuli affect psycho-social-spiritual processes as a combination of both observer and stimulus factors. While this perspective has already been successfully employed in explorations of how aesthetics influence moral decision-making (Kim, Cunningham, and Aribarg, 2022), it does not address how preexisting religious and spiritual beliefs may influence the aesthetic experience just as much as the other way around.

While very little research has been conducted examining how religiosity leads to differences in preferences for visual art – especially when considering religious versus secular stimuli – some explorations have considered the influential factor of religion in other aesthetic domains. One study, for example, explores preferences between religious and non-religious individuals in visiting a tourism location for spiritual practice and benefits – such as Tibet – versus a hedonistic, or pleasure-indulgent, tourism location – such as Haiti – as a function of awe experiences (Van Cappellen & Saroglou, 2012). They find that awe appears to activate religious and spiritual decision-making and

behavioral intentions when it comes to endorsing one aesthetic location over the other. These findings imply that the influence of religiosity is contextual and highly based on emotional responses to a stimulus. Furthermore, one study exploring relationships between certain personality traits and aesthetic preferences of different artistic mediums – namely visual art and music – showed an association of preferences between visual art and music genres (Ercegovac, Dobrota, & Kuščević, 2015). While religiosity as an individual factor was not considered, associations were drawn between certain genres of music and paintings with religious motives: for example, preferences for popular music was positively correlated with appreciation of religious paintings, while preferences for heavy metal music were negatively correlated. The results of this study indicate the role of personality factors and general aesthetic preferences in appreciation of religious artworks, though which personality factors and how religiosity in general influences those preferences remain to be seen.

Where investigations have explored the connection between religiosity and artworks, they have shown a limited role of religious identity on aesthetic preference. One study reports that Protestant Christians were surprisingly appreciative of modern artworks in comparison to other groups, including Roman Catholics, non-religious individuals, and agnostic individuals (van Eijck, 2012). In addition, atheist participants appreciated classical styles of artworks almost as much as Roman Catholic participants did, which was contradictory to the author's hypothesis. These results indicate that other variables – such as age, gender, and educational background – might play a stronger role than religious identity when it comes to preferences for artistic styles, though this has not been thoroughly explored. With the present research in mind, it remains to be seen how religious beliefs and practices may influence preferences and appreciation of visual artworks which are either explicitly or implicitly religious in nature or content.

4.1.2 Light Variation: a Unique Aesthetic Feature of Stained-Glass Windows

Unlike other forms of visual art, stained-glass windows possess a unique characteristic of their aesthetic value: their interaction with light, a natural aesthetic feature. As discussed in Chapter 1, the manner in which natural and artificial aesthetic objects and scenes are appreciated is fundamentally different (Chirico, Clewis, Yaden, & Gaggioli, 2021). Whereas artistic objects can be aesthetically judged based on a number of formal elements and stylistic choices – which can be cultural or otherwise influenced by individual preferences – natural scenes and objects are judged based on more universal attributes which are recognized and appreciated as uniform aesthetic elements (Vessel, Maurer, Denker, & Starr, 2018). Furthermore, aesthetic appreciation of natural objects and scenes tend to be more intense and emotional during appraisal than the appreciation of human-made artefacts (e.g. Carlson, 2005; Chirico et al., 2021; Di Dio et al., 2016; Kardan et al., 2015; Smalley & White, 2023; Vessel et al., 2018). These differences in mind provide context for the exploration of how natural and artificial aesthetics may interact to formulate a complete aesthetic experience, such as that witnessed when viewing stained-glass windows.

While very little research has examined the aesthetic potential of stained-glass windows and their connection with light, some studies examining architectural design and placement have noted the importance of shadow and light manipulation to create the full aesthetic experience. Edensor and Hughes (2021), for example, discuss the essential presence and contribution of light and shadow towards the experience of space in urban design. According to the authors, the way people perceive and conceive of the world is dependent upon the quality, shape, and nature of light which fills the given space. In relation to the perception of artworks, Schielke (2020) also discusses the importance of lighting in museum spaces, both for ease of visibility and for setting

a tone in which the artworks can be interpreted and appreciated. Much like Day's (1909) argument that certain stained-glass windows are better appreciated in different lighting conditions in comparison to others, Schielke values light as an important tool which allows museum curators to 'define the atmosphere for viewing art, establish a sense of drama to support its reception, and generally contribute to the success of the exhibition' (p. 7).

Unlike Schielke's description of light's role as a bottom-up factor in art appreciation, however, Allen (2012) highlights the necessary role of light when it comes to viewing and appreciating stained-glass windows. Whereas painted works may be enhanced by certain lighting conditions, stained-glass windows are reliant on them for their effect; without the presence of light, the painted glass is dull and dark, unable to be appreciated for its full potential (Read, 1926). This interaction with light as a necessary feature of the viewing experience adds a kinesthetic element to stained-glass windows which is constantly in flux (Allen, 2012). As Day (1909) describes, viewing a stained-glass window at one point during the day is an entirely different experience from viewing it later, or under different environmental conditions. While the artistic structure – pertaining to the design, the content, the scale, and the colour – never changes, the context in which these features are viewed is constantly changing and presenting of a new aesthetic experience (Day, 1909). This reliance on light as a necessary factor of its aesthetic experience makes the medium of stained-glass windows a unique one to consider for scientific exploration.

As previously mentioned, some theoretical work has been conducted in this area considering the impacts of light on the perception of space and aesthetic objects; however, very few empirical investigations have been conducted to examine these effects from a scientific perspective. One notable study conducted by Abboushi, Elzeyadi, Taylor, and Sereno (2019) examines the effects of projected

light fractals on architectural spaces on visual interest and preferences. Their findings suggest that interest in light fractals is formed partially in relation to the complexity of the light patterns: in light with theories of visual complexity in relation to aesthetics (Berlyne, 1970, 1971), patterns that were rated as medium to medium-high in visual complexity garnered the most interest from participants. Notably, the researchers did not assess whether preferences existed for other factors of light variation, such as intensity or movement. While some further exploration has been conducted on the impacts of diurnal changes on the evaluation of landscape scenes (Smalley & White, 2023), the specific effects of light and light variation as factors of aesthetic experiences require further pursuit.

4.1.3 The Present Study

Prior research on aesthetics has demonstrated the influence of specific features on aesthetic perception, but very little consideration has been given towards more dynamic elements. Furthermore, while research recognizes distinct differences between natural and artificial aesthetic objects (Chirico et al., 2021), it has yet to be examined how a setting which applies both kinds of aesthetics can create a complex, unique experience. The present study examines how a combination of these features exists within the aesthetic evaluation of stained-glass windows and how differences in these features – demonstrated here in the form of light variation – influence aesthetic judgment of the artistic work. It has been established that stained-glass windows are a unique form of art which utilize light as an essential factor of their experience, and it has been noted how the ever-changing interaction between light and glass is constantly shaping the viewing of the artwork into a new experience each time (Day, 1909; Leroux, 2013). Therefore, it can be hypothesized that viewings of windows with some form of light variation will be appraised as more aesthetically pleasing than the control images, which will exhibit ‘diffuse’ or even, unmoving lighting across the entire

focus of the image. It can be further presumed that the overall preference will be for dynamic light variations, as the dynamic scenes will be more realistic to the viewer than the static scenes (Hekkert & Van Wieringen, 1990; 1996).

Furthermore, the present study seeks to examine how intrinsic religiosity and self-reported religious beliefs influence the aesthetic appreciation of religious objects. Based on prior research, it can be assumed that participants who self-identify as having more intrinsic religiosity – in this case intrinsic Christianity – will prefer religious artefacts more than non-religious participants. In the following procedures, we hope to shed some light on the role of specific aesthetic features and their interactions with individual differences during aesthetic appraisal, especially as it pertains to religious artefacts and combined aesthetic experiences.

4.2 METHODS

4.2.1 Participants

52 participants (ages 19-75, M = 34.78, 30 females, 22 males) were recruited to complete the present online experiment. 5 individuals were recruited from the School of Psychology undergraduate population at Trinity College Dublin, 11 were recruited using posters advertised around the campus, and the remaining 36 participants were recruited utilizing the online platform Prolific. Eligible participants from the School of Psychology were offered 1 research credit as compensation for their participation, while participants recruited via Prolific were compensated at a rate of £9 per hour. All other participants were offered a €5 digital voucher for National Book Tokens as compensation. Following the completion of data collection, one participant was excluded due to only responding to half of the stimuli, leaving the final participant count at 51.

4.2.2 Design

The present study utilised a 2 x 3 mixed design, with the independent variables in question being the three levels of light variation – dynamic, static, and diffuse as the control condition – and the level of intrinsic Christian religiosity of the observer. Participants completed the Short Christian Orthodoxy scale (SCO; Hunsberger, 1989) prior to completing the experiment in order to measure their intrinsic Christian religiosity. Their answers were summed across all six items, with three items being reverse scored according to the authors' descriptions (M = 19.365, SD = 10.783). Participants were then divided into two groups based on a median split of the data: 'religious' and 'non-religious'. We examined these variables in order to determine differences in aesthetic pleasure as reported on the Aesthetic Pleasure in Design scale (APID; Blijlevens et al., 2017), which 'measures the aesthetic response as such' and could therefore be generalized across different forms of aesthetics

(p. 94). The experiment was conducted using the open-source experimental software PsychoPy, and was hosted on the online platform Pavlovia for testing. Participants completed the study online via a link provided for them through the Trinity College Dublin SONA system, through the Prolific system, or through direct correspondence with the researcher. Careful attempts were made to counterbalance the participants between 13 versions of each experiment, with each experiment version containing one of the 13 versions of each stimulus image. Each participant only viewed one light variation version of each window in an experiment setting, and they viewed all 13 light variations in a random order applied across the 40 stimuli. This was done to ensure an equal number of answers would be given for each stimulus version.

4.2.3 Stimuli

40 stimuli images with diffuse were selected for use in this study based on the procedures conducted in Chapter 2. The original versions of these images were utilised as our 'control' group. In order to create the light variation conditions, video clips taken from free online sources – such as Shuttershock, Pond5, and Pexels – were animated into the background of the stimulus images using the open-source programming software Processing (v. 4.3). We created seven stimulus 'categories' with these edits, which included the control images (see Figure 4-1 for examples), and applied them to the static and dynamic conditions to produce thirteen 'versions' of each image: one control, six static, and six dynamic. Images with diffuse lighting were also edited using Photoshop to create a black background in areas where the outward frame was visible in order to reduce any errors in the animation and increase the contrast between the window and the background. We then produced 150 frames of each animation for every stimulus image and integrated them into an mp4 format using MATLAB R2023a in order to create our dynamic stimuli. Static stimuli versions of each image were created by selecting one of the 150 frames produced to characteristically

represent each light variation. Diffuse and static image versions were then converted from .jpg into .mp4 formats using PowerPoint's video export function in order to simplify the experimental design.

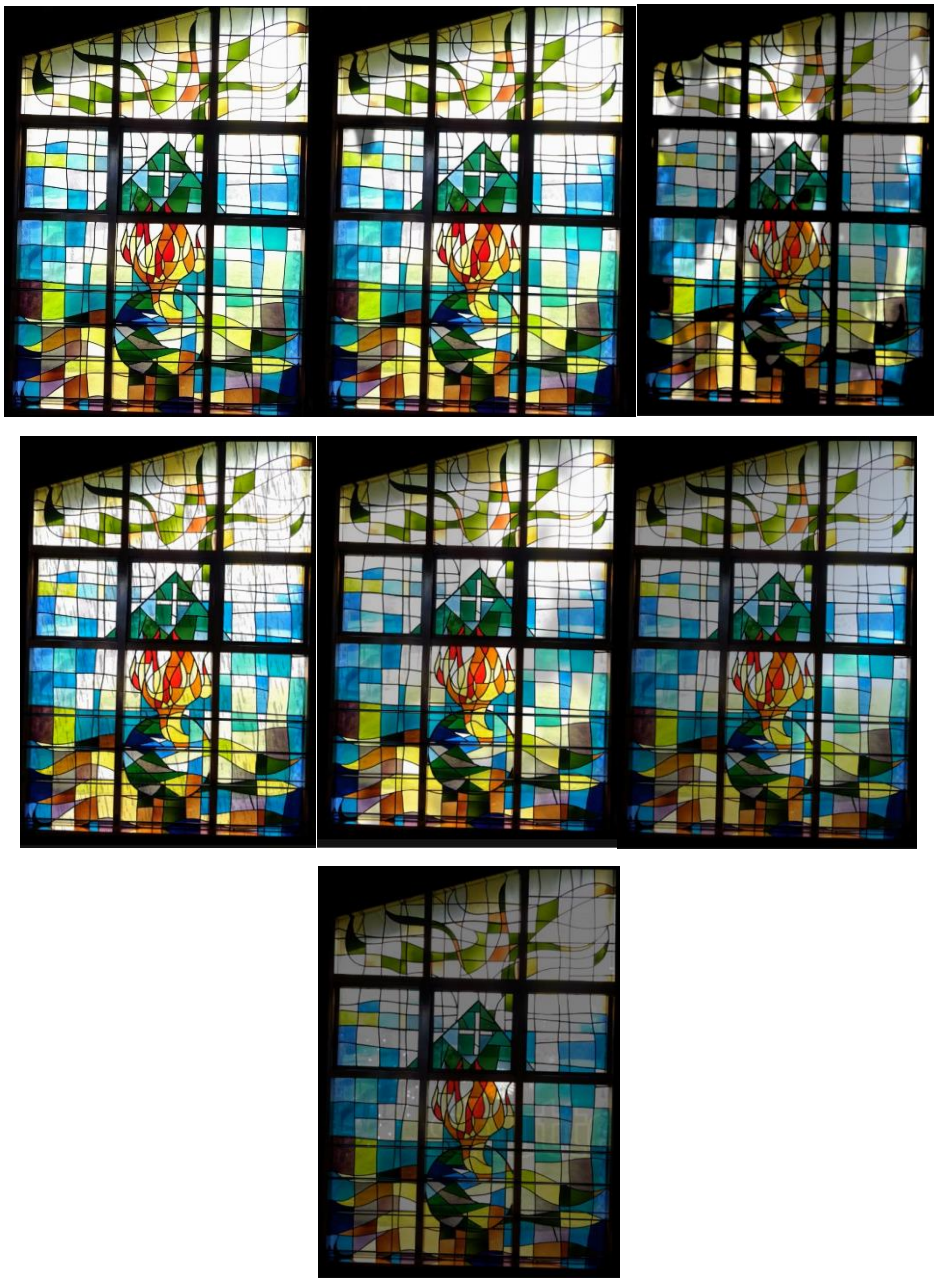

Figure 4-1: Examples of static and control categories of stimuli as they were presented to participants. From left to right (top): control/diffuse, bird, tree, and rain; (bottom) cloud, lightning, and fireworks. These stimuli were shown either as static images or as dynamic videos.

4.2.4 Procedures

After providing their consent to participate, participants responded to several preliminary questions relating to their demographic information and levels of Christian Orthodoxy – as detailed by their answers to the SCO – in an online survey administered via Pavlovia. Upon completion of the survey, participants were automatically redirected to the experiment.

During the experimental procedures, participants were required to view and respond to the given material on a Windows PC or Mac computer. They were asked to view 40 randomised trials of stimuli, ranging across the three conditions – dynamic lighting, static lighting, and the control – and respond to six questions randomly ordered and relating to their aesthetic evaluation of the windows. These questions included five questions from the aesthetic pleasure construct of the APID plus one question pertaining to the viewer's familiarity with the window, as novelty is known to influence aesthetic appreciation (see Chapter 2): 'Before today, I was familiar with this specific window.' Participants completed two short practice trials prior to beginning the experiment in order to familiarize them with the procedures. For each trial, participants viewed a white fixation cross on the screen for one second in order to draw their focus to the centre of the screen. Then, the cross would disappear and the stimulus video would appear and play for five seconds as a pre-question preview. After this preview, the video would remain on the screen in a smaller format and play in a loop while participants answered questions on a 7-point Likert scale. Responses were recorded by pressing the corresponding number keys at the top of the participants' keyboards to indicate their answers to each statement, with '1' representing 'strongly disagree', '4' representing 'neutral', and '7' representing 'strongly agree'.

Once they had completed all 40 experimental trials, the participants were thanked for their time, provided with a link to the

official debriefing sheet, and automatically redirected either to the SONA portal to receive their research credits or to the Prolific portal to be allocated their compensation funds. Participants who were part of neither participant group were also redirected to the SONA portal, but were asked to contact the researcher to confirm their submission and receive their compensation.

4.3 RESULTS

All data analyses were conducted in RStudio v. 2023.06.1. Prior to data analysis, a Shapiro-Wilk test was conducted in order to determine whether responses to the APID were normally distributed. The data was found to not be normally distributed, $W = 0.969$, $p < 0.01$; therefore, only non-parametric tests could be carried out on the present data set. No outliers were detected.

4.3.1 Light Variation as a Factor of Aesthetic Appreciation

The differences between light variation conditions in terms of aesthetic pleasure are illustrated in Figure 4-2. In order to measure the differences between responses for each condition, a Kruskal-Wallis test was conducted. Results showed that the differences between groups were not significant, $\chi^2(2) = 5.850$, $p = 0.054$, with a mean rank score of 4.48 for the control condition, 4.29 for the dynamic condition, and 4.18 for the static condition.

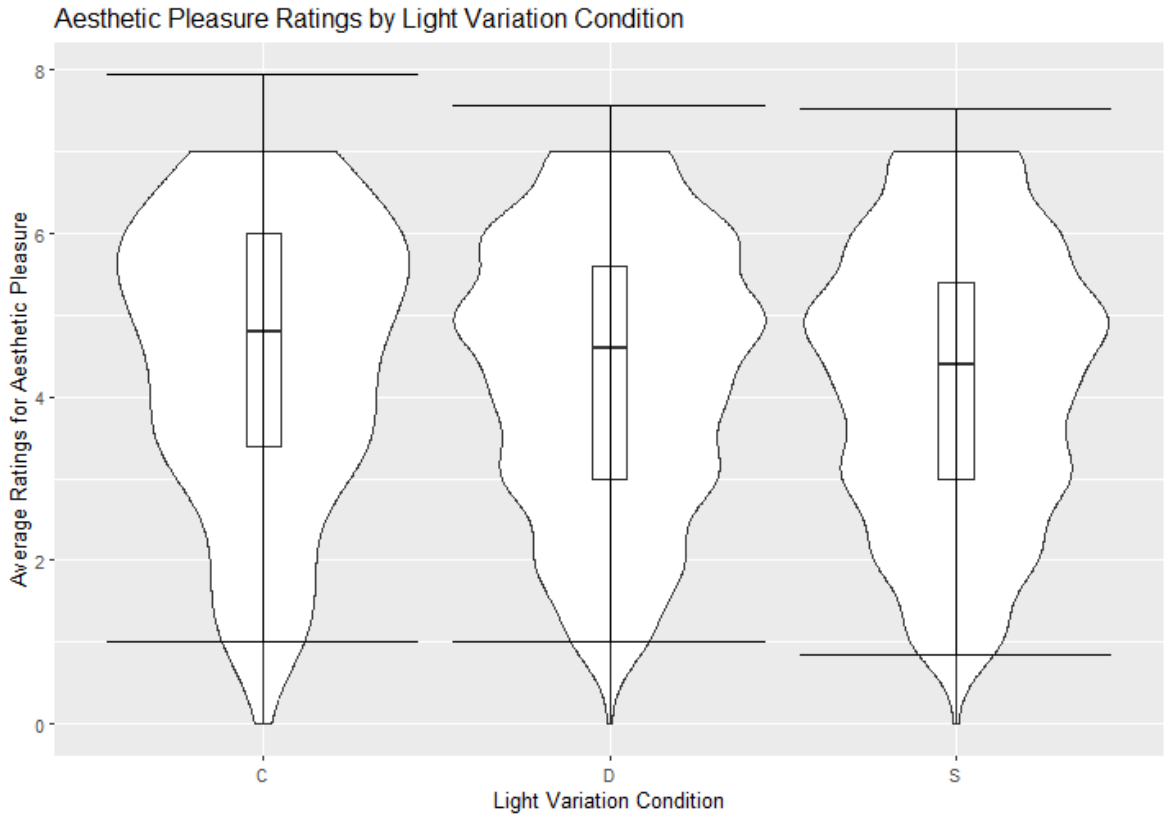

Figure 4-2: Differences between light variation conditions. From left to right: control condition (M = 4.48, SD = 1.73), dynamic condition (M = 4.29, SD = 1.64), and static condition (M = 4.18, SD = 1.67). No significant differences in means were detected between the three conditions.

We then examined the differences in ratings between the seven light variation categories (listed in Figure 4-1). These results are illustrated in Figure 4-3 and further detailed in Table 4-1. A Kruskal-Wallis test was conducted and found there were significant differences in preferences for light variation versions: $\chi^2(6) = 20.276$, $p < 0.01$; mean rank scores for each version are also listed in Table 4.1. A Dunn's z-test approximation with Bonferroni correction applied found that no category pairs were significantly different from each other when p-value was adjusted.

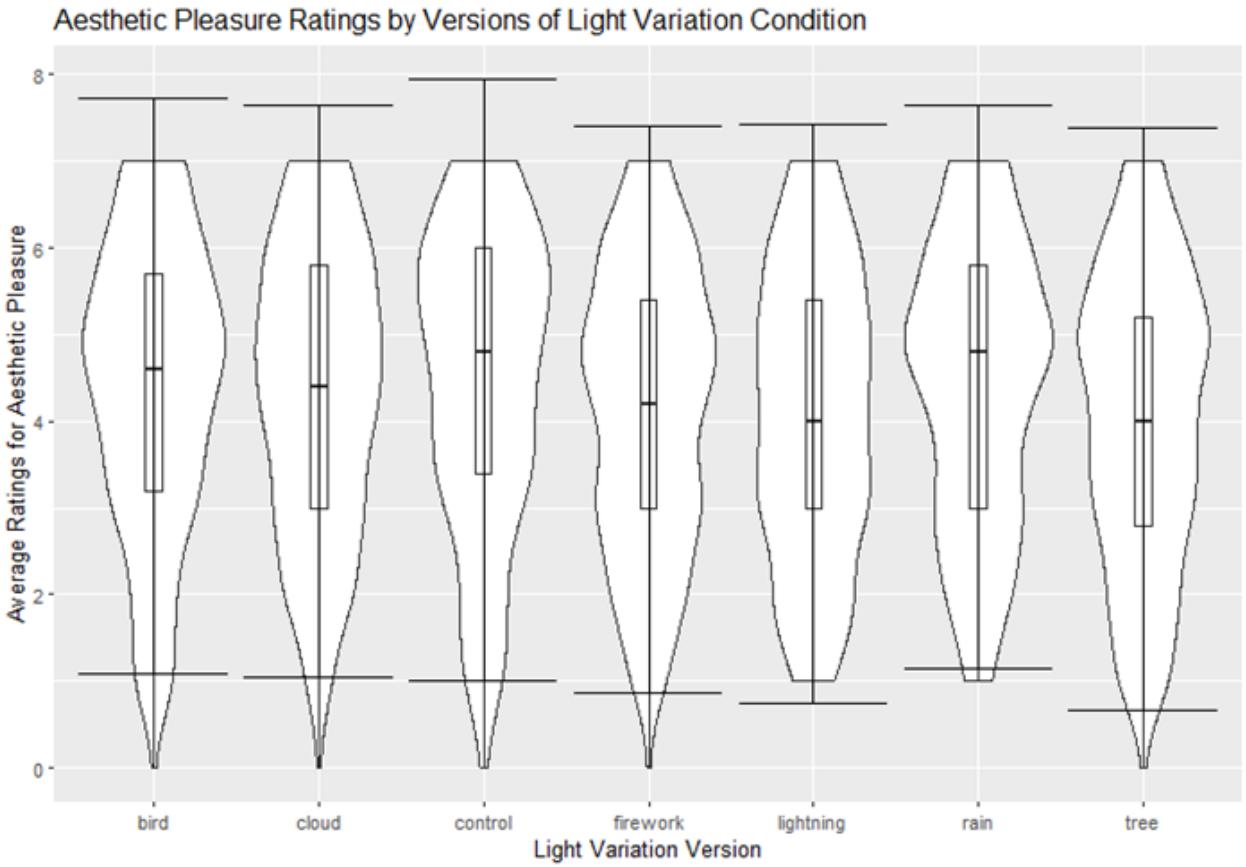

Figure 4-3: Comparisons between 7 light variation categories (from left to right): bird, cloud, control, firework, lightning, rain, and tree. Overall, the control condition was the most strongly preferred out of all of the categories, with the tree and the lightning being the least preferred.

Category	Overall Mean/Std.Dev	Dynamic Mean/Std.Dev	Static Mean/Std.Dev
Control	M = 4.48 SD = 1.73	-	-
Bird	M = 4.41 SD = 1.66	M = 4.36 SD = 1.72	M = 4.46 SD = 1.60
Tree	M = 4.03 SD = 1.68	M = 4.20 SD = 1.64	M = 3.86 SD = 1.71
Rain	M = 4.40 SD = 1.62	M = 4.54 SD = 1.57	M = 4.27 SD = 1.67
Cloud	M = 4.35 SD = 1.65	M = 4.35 SD = 1.66	M = 4.34 SD = 1.65
Lightning	M = 4.08 SD = 1.67	M = 4.10 SD = 1.66	M = 4.06 SD = 1.68
Fireworks	M = 4.14 SD = 1.63	M = 4.15 SD = 1.60	M = 4.12 SD = 1.67

Table 4-1: Averages and standard deviations of responses to light variation categories. This includes responses to the seven categories overall as well as responses to the static and dynamic versions of the categories. While the control condition was the most preferred out of all of the categories, the dynamic rain was the most preferred category version.

4.3.2 Religiosity Differences

Responses to the SCO (M = 19.5, SD = 10.8) were totaled and participants were divided based on a median split (m = 18) into 'religious' (n = 26, M = 28.5, SD = 7.04) and 'non-religious' (n = 25, M = 10.1, SD = 3.41). A Shapiro-Wilk test of normality found the data were not normally distributed, either overall ($W = 0.922$, $p < 0.01$) or within religiosity groups (religious $W = 0.946$, $p < 0.01$; non-religious $W = 0.889$, $p < 0.01$). Because the data was non-parametric, a Wilcoxon rank sum test was conducted between the two groups. The analysis

found no significant differences in aesthetic pleasure ratings, W = 290, p = 0.531 (see Figure 4-4).

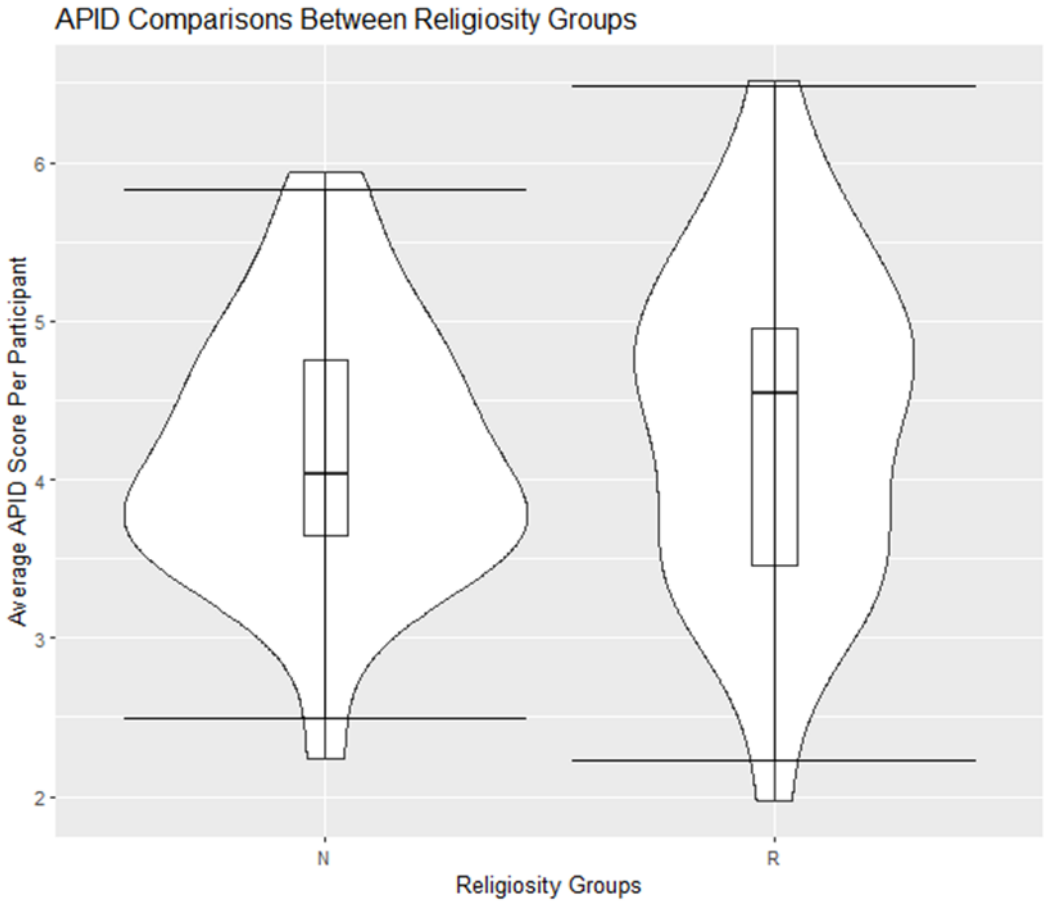

Figure 4-4: Illustrations of average APID scores between religiosity groups. Religiosity was determined based on a median split (m = 18), and a Wilcoxon rank sum test was conducted to determine differences in aesthetic preference between them. No significant differences were found.

4.4 DISCUSSION

The present investigation explored the influence of different light variation conditions – dynamic, static, and diffuse – as well as different ecological examples within those conditions on the perception and judgment of religious stained-glass windows. Results showed that while different light variations in general may influence aesthetic liking and preferences, it appears to be more reliant on the type of light variation being witnessed. For example, while there were no significant differences between the control, dynamic, and static conditions, there were significant differences between light variation categories: the control condition appeared to be the most appreciated out of all of the light variation categories, while the lightning and tree categories were the least appreciated. These results imply that not only does light variation have very little effect on aesthetic evaluation of stained-glass windows, but also that where it does serve an impact, it is detrimental to the effect.

Because investigations into the nature of stained-glass windows as aesthetic objects is so new, there is little existing research to inform the reasoning behind these results. In one study examining the differences in diurnal changes on urban and rural landscape scenes, Smalley and White (2023) report significant differences between their 'blue sky' control scenes and other forms of weather variation, with scenes of sunrises and sunsets being the most preferred and scenes of nighttime and storms being the least preferred. In comparison with the present study, their findings also suggest that specific contexts and variations may have stronger effects than others on aesthetic liking, preference, and evaluation; however, because the present study's results seem to counter Smalley and White's with an overall preference for the control condition, it remains to be seen how generalizable these results are in terms of aesthetic scenes and objects.

One potential explanation for the preference for diffuse lighting over either static or dynamic conditions could be, simply, the setting in which the windows are depicted. As has been discussed in Section 1 of this chapter, one of the most unique factors of aesthetic experiences when viewing stained-glass windows is their kinesthetic nature: while their content and artistic elements do not change, the context in which they are viewed influences the perspective and impact of their aesthetic evaluation. In the current study, the windows have been purposely stripped of their context and are instead being viewed in isolation, which may have removed certain elements which would otherwise have been necessary for aesthetic judgment. In research, this dilemma has been considered in terms of the representative value of photographs when viewing a landscape: for example, Kroh and Gimblett (1992) report that aesthetic assessments of natural scenes were more intense and higher in rating when being viewed in-person in comparison to as photographs in a laboratory setting. They cite the influence of multisensory variables as key factors of these differences. Sevenant and Antrop (2011) report similar findings but note a dependency on the nature of the stimulus being depicted in the photograph and the particular visual factors being evaluated. Vastness, for example, is difficult to capture in a photograph in comparison to *in situ* viewings because it cannot capture the true size and impact of the space depicted. In the present study's case, it may be that the photographic images used as stimuli do not capture certain aesthetic elements which would otherwise be incorporated during an in-person viewing.

In addition to investigating light variation alone, we also explored the potential influence of religiosity as an influence of aesthetic preferences for religious stained-glass windows. Surprisingly, religiosity alone did not significantly correlate with aesthetic pleasure when viewing religious stained-glass windows. This finding is contrary to other research efforts considering the link between religiosity and religious

aesthetics, which find, overall, that greater levels of religiosity lead to greater preferences for religious artefacts and scenes (e.g. Van Cappellen & Sarouglou, 2012; van Eijck, 2012). Instead, our results are consistent with one recent study's findings into aesthetic judgments of artworks of saints and non-saints (Schieppati, Di Dio, Marchetti, Massaro, & Gilli, 2022). In their study, researchers reported that the religiosity and spirituality of individual participants was not associated with either aesthetic or vitality judgments; instead, judgements were based on the content of the artworks and the individuals depicted in them. As the authors report, these findings suggest that more bottom-up processes of perception and judgment are involved in the case of religious artworks, though further exploration is necessary in this field.

In addition, while the SCO does measure Christianity in general, it does not take into account the various beliefs of different denominations; because our stimulus pool comprised of a mixture of Catholic and Protestant imagery, it is possible that differences between denominations led to preferences for the content of some windows over others, and this led to more variability in aesthetic responses than would be expected. For example, several of the windows depicted purely Catholic iconography, such as the Virgin Mary or various saints. The variability of our sample may also have contributed to this disparity when it comes to preferences between more 'traditional' and more 'modern' art: as van Eijck (2012) reports, individuals who self-report as higher in religiosity also tend to prefer artworks which comply with more 'traditional' styles and elements in comparison to more 'modern' artworks. Therefore, the content and style of the stained-glass windows themselves may have influenced the effects of religiosity on aesthetic appreciation of religious artworks.

4.4.1 Limitations and Implications for Future Research

In consideration of future research designs which may examine how light variation impacts aesthetic experiences when viewing stained-

glass windows, several limitations of the present study should be considered. First and foremost, the present study utilised an experimental, online setting in order to explore how specific light variations influenced aesthetic judgment. While this design offered many benefits – most notably the ability to control the light variations being shown – it also came with many challenges which must be discussed. For example, in displaying images windows on a 2D screen – rather than presenting participants with actual windows to examine – the aesthetic effects may have been altered and not completely encompassed by the boundaries of the screen. We may not look through stained-glass windows so much as upon them (Allen, 2012), but it is possible that by removing the ability to look through the stimuli, we have negated their effects. This is demonstrated in experiments examining how the context of a viewing influences aesthetic appreciation of an artwork, wherein museum or art gallery settings are often significantly preferred to laboratory settings (e.g. Brieber, Nadal, & Leder, 2015; Brieber, Nadal, Leder, & Rosenberg, 2014; Specker, Tinio, & van Elk, 2017; but see Brieber, Leder, and Nadal, 2015, for counterevidence).

Furthermore, as is often the case, the online setting of the experiment left many potential influencing factors uncontrolled, such as the environment in which the experiment was being taken, the accuracy and honesty of participants' answers, and the avoidance of technical errors due to the different devices which participants completed the experiments on. While some of these factors could be partially controlled for – such as limiting experimentation to a laptop or desktop computer and instructing participants to clear their browser caches before beginning the experiment – others remain challenges as byproducts of the setting in which the experiment has been placed. Future research may consider focusing on more in-person investigations in order to explore aesthetic responses in a more controlled, unvaried environment.

Finally, one significant factor which is not taken into consideration in the scope of this study is the role of context during viewing. Aesthetic research has noted the role that context plays during judgment processes: for example, Swami (2013) reports that content-specific contextualizing information significantly increased understanding and appreciation of abstract paintings. It has also been reported that different types of artworks presented in expected and unexpected contexts yield different aesthetic judgments: for example, graffiti art presented in the context of an urban street was rated higher in aesthetic liking than when it was presented in a museum context, whereas modern art was preferred when it was featured in a museum context over an urban street context (Gartus & Leder, 2014). This is further illustrated in Swami (2013)'s investigation, wherein the presence of irrelevant contextual information did not improve appreciation of the artwork being observed. As this is one of the first considerations of stained-glass windows which have been applied in the field of aesthetic perception, it is unknown if this artistic medium may be just as or more sensitive to the presence of context than has been previously observed. It is highly recommended, therefore, that future research examine how context plays a role in the aesthetic judgments of stained-glass windows.

While field research is certainly a possible solution in this regard and could yield some very beneficial results, utilizing these techniques creates a challenge of a lack of control: one of the benefits of the present study's procedures was the ability to control what light variations were being viewed in order to more easily analyse their impact in isolation. One possible solution to this challenge arises in the form of virtual reality: as Lin, Chen, and Lin (2020) describe, virtual reality has grown over the past few years to be utilised as an efficient tool for studying aesthetic experiences, and improvements in the technological field are bridging the gaps between appreciation in reality and in virtual reality.

While there are several challenges to be considered in its use – such as the possibility of motion sickness during viewing (e.g. Chirico, Yaden, Riva, & Gaggioli, 2016; Chirico et al., 2021) – it can offer the opportunity to examine stained-glass windows in relation to their context while also maintaining a controlled environment during their evaluation. Future studies in this discipline may explore virtual reality as an efficient tool for examining aesthetics in context, especially when it comes to cases of combined aesthetic factors such as in the case of stained-glass windows.

4.5 CONCLUSIONS

This investigation marks one of the first explorations into the role of light variation and the aesthetic potential of stained-glass windows as kinesthetic, artistic objects which can create unique, dynamic experiences depending on the context in which they are viewed. Differences in light variation conditions in general – pertaining to moving, dynamic light; static, unmoving light, and diffuse lighting – were not observed, but differences in specific light variation categories – such as a bird flying across a window, a tree moving in the wind, rain falling behind the panes, etc. – were, to an extent. Notably, this study offers counterevidence to the direct relationship between intrinsic religiosity and a preference for religious objects: we suggest that religiosity may not play as large of a role as has been previously expected. While the effects demonstrated in this study are limited in their application, this remains the first exploration into the role of light variation in a unique aesthetic context. Future research may seek to explore the implications of these results by utilizing a design which examines the role of context in aesthetic evaluation: How does the space a stained-glass window is placed in influence judgments about its beauty and aesthetic value? How might other individual factors interact with light variation effects in order to influence aesthetic judgment? How does viewing a stained-glass window in a laboratory setting (such as was demonstrated here and in Chapter 3) differ from viewing it in a more natural setting, such as a church or an art museum? As this unique form of aesthetics continues to emerge within the field, these questions and more may be considered.

CHAPTER 5: GENERAL DISCUSSION: STAINED-GLASS WINDOWS AND NEW CONTRIBUTIONS TO RESEARCH IN AESTHETIC PSYCHOLOGY

5.1 OVERVIEW

The world around us is made up of aesthetic objects, and we are constantly forming judgments about and responding to these objects. How we formulate these judgments and responses is based on a number of factors relating to our own experiences and personalities as individuals and to the sensory information we take in about the object itself. The field of aesthetic perception has grown exponentially in recent decades to consider how these factors – labeled 'top-down' and 'bottom-up' factors, respectively – interact with each other in order to create our perceptions and preferences for different aesthetic experiences (e.g. Brattico, 2015; Chen & Mongrain, 2021; Gallagher et al., 2015; Leder et al., 2004; Lindell & Mueller, 2011; Reinerman-Jones et al., 2013; Pelowski et al., 2017; Pilgrim et al., 2017; Walker et al., 2017). While the field has considered aesthetic experiences that derive from either natural or artificial factors – such as natural landscapes in comparison to architecture and urban scenes – research has neglected the exploration of aesthetic objects which act as a combination of different factors to engage the viewer in a sensory experience. With this in mind, the nature of stained-glass windows as an artform which relies on the natural element of light as an essential part of its function can provide the discipline with novel insights into how specific features can interact with each other and with observer traits to engage processes of aesthetic perception and appreciation.

The purpose of the present study was, chiefly, to investigate the bottom-up and top-down factors which influence aesthetic judgments of and emotional responses to images of religious stained-glass windows. In the context of the two experimental investigations outlined in this

thesis, we illustrated the essential influences of feature-specific elements in determining how stained-glass windows as artistic objects are perceived. This is, to our knowledge, the first set of explorations into the aesthetic potential of this medium, and so this chapter will consider our findings in the context of a growing body of literature surrounding aesthetic perception. We will discuss not only how the results of our investigations align with prior research into aesthetic perception and individual differences, but also how future research may expand upon these explorations in consideration of stained-glass windows as a unique artistic medium. In our review of the present research, we propose the utility of stained-glass windows as a new avenue of thinking about aesthetics and a vehicle for future investigations into how natural and artificial aesthetic features are combined to form one distinctive experience.

5.2 INSIGHTS AND APPLICATIONS INTO THE ROLES OF BOTTOM-UP AND TOP-DOWN PROCESSING IN AESTHETIC PERCEPTION

The question of how we perceive aesthetic experiences and what specific factors influence that perception – be they originating from the observer or from the experience itself – is a pressing issue not only for the discipline of aesthetic perception, but also for the field of psychological perception in general. Distinguishing how interpretations of the external world are formed based on individual perceptions and sensory information allows researchers to begin to understand how people proceed to make decisions and interact with objects in their environment.

The effects of top-down factors appear to be mixed based on which factor is being assessed and under what circumstances. Expertise, in particular, has been a key focus in this area of research as it relates to how individuals process information and pay attention to specific details in an artwork or other aesthetic object (Leder et al., 2004; Leder et al., 2014; Leder & Nadal, 2014; Silvia, 2006, 2013). The impact of expertise specifically has been shown to be so significant that it even mediates the effects of other top-down variables, such as culture (Darda & Cross, 2022). Surprisingly, based on prior research (Schieppati et al., 2022) as well as our own findings, religiosity as a top-down factor has been shown not to have as strong of an influence on aesthetic judgments as other personal differences, even when considering religious stimuli. In cases where religious differences have been featured, other factors – such as awe experiences (Van Cappellen & Saroglou, 2012) – have either mediated group effects or simply demonstrated stronger impacts on aesthetic preferences. These findings not only imply distinct differences in how top-down factors influence aesthetic perception, but also support information-processing models such as that proposed by Leder and colleagues (2004; Leder & Nadal, 2014).

The ways in which top-down and bottom-up features interact with each other during processes of aesthetic appraisal continue to pose questions for future research. Our findings in this thesis indicate a strong influence of factors which are drawn from sensory information during observation of the stimulus over factors based in individual experiences. These implications are especially important as we consider how different categories of aesthetic objects and scenes – specifically natural and artificial aesthetic experiences – are appreciated differently. In contrast to artificial aesthetic objects, for example, appraisals of natural aesthetics – such as landscapes or facial features – are more universal and considerate of sensory information on its own (Vessel et al., 2018; Vessel & Rubin, 2010; Ulrich, 1983). For example, Leder, Goller, Rigotti, and Forster (2016) also find that preferences for certain facial features are significantly more shared between individuals. In light of this research, our present findings examining stained-glass windows as artistic objects provide a closer look at how stained-glass windows function in relation to both artistic and natural elements. While the implications of our findings suggest that stained-glass windows seem to evoke stronger evaluations of bottom-up features than those based in personal experiences and preferences, future research may seek to examine these effects further in the scope of contextual features, such as the location, position, and surrounding environment of the windows presented.

The applications of the present research findings can be considered under two perspectives: the pursuit of future research for aesthetic psychologists, and the cultivation of interest by art historians, museum curators, and stained-glass window enthusiasts in the empirical potential of their medium. Regarding the former, stained-glass windows present a novel perspective for viewing aesthetic experiences as an interaction of natural and artificial elements. They provide a means of examining how art not only benefits from the presence of natural

phenomenon, but relies on it: without light, the aesthetic effect of stained-glass windows could not be captured or communicated to the observer. In pursuit of expanding research considering the relationships between top-down and bottom-up features – especially in the context of different types of aesthetic stimuli – stained-glass windows provide a new perspective through which to examine aesthetic experiences and the ways in which people appreciate and judge art.

Concerning the latter group – academics, curators, and enthusiasts interested in the artistic potential of stained-glass windows – the present research draws attention and interest to the crucial function of their medium as a representative of a unique form of aesthetics. Stained-glass windows are often overlooked for their potential as works of art and representations of religious and historical evolutions; this is especially true in Ireland, wherein no stained-glass windows constructed prior to the 19th century survive (Rosewell, 2012). As focus for empirical research begins to incorporate stained-glass windows as artistic mediums, art historians and academics should begin to consider how this unique form of art can be appreciated and studied for its role in history and its ability to convey artistic elements in a profound way.

5.3 KEY FINDINGS AND FUTURE RESEARCH

5.3.1 Pupil Dilation as a Physiological Measurement of Awe

One challenge presented in research studying awe and other complex emotional experiences as responses to aesthetic objects and scenes is finding an efficient and accurate means of measurement. The primary method for doing so thus far has been relying on self-report measures (e.g. Büsing et al., 2018; Krenzer et al., 2018; Shiota et al., 2007; Yaden et al., 2019), which, like other self-reports, can be subjective in their definitions of awe and in participants' interpretations of their experiences (Chirico et al., 2017; Paulhus & Vazire, 2007; Reinerman-Jones et al., 2013). There is, therefore, a growing interest in finding objective means of measuring awe – such as through brain imaging studies (e.g. Hu et al., 2017; Gallagher et al., 2015) – which can provide insight into how complex emotional processes are demonstrated through physiological reactions. In Chapter 3, we were able to demonstrate a significant positive relationship between pupil dilation and self-reported awe experiences when viewing images of stained-glass windows. Our findings support prior research examining pupillometry as a demonstration of general emotional experiences (e.g. Bradley et al., 2008; Partala & Surakka, 2003) and awe specifically (Takano & Nomura, 2023).

Application of these findings for future research is twofold. First, the results of Experiment 1 demonstrate one way in which awe can be objectively and physiologically measured during aesthetic experiences in response to visual stimuli. Second, our findings support the position of awe as not only a strong emotional experience, but also a cognitive one. Research has shown that pupils dilate during active cognitive processes and stages of decision making (Aston-Jones & Cohen, 2005; Gilzenrat et al., 2010; Simpson & Hale, 1969) along with emotional experiences. Awe has often been characterized as a cognitive emotion which facilitates learning, memory, and other mental processes

(Valdesolo et al., 2017), and our findings appear to provide support for that connection. Future research, therefore, may seek to examine the utility of pupil dilation as a demonstration of awe experiences in other aesthetic contexts, particularly in relation to non-visual or multisensory experiences wherein the limitations of using visual stimuli – especially the influence of colour variations, in this case – may not be a prominent influence.

5.3.2 Expertise and Aesthetic Liking of Stained-Glass Windows

In Chapter 3, we report that while expertise does not significantly affect reported awe experiences or evaluations of beauty when viewing stained-glass windows, it did significantly affect ratings of liking. This finding is in line with existing research surrounding the influence of expertise as a top-down factor, wherein experts typically respond with higher ratings of liking than non-experts when examining artworks in their field of knowledge (e.g. Leder et al., 2004; Mullenix & Robinet, 2018; Silvia, 2013). While we were able confirm the generalizability of research assessing how expertise facilitates aesthetic liking, we notably found no significant difference between experts and non-experts when it came to awe experiences. These findings are interesting as prior research has shown that experts tend to experience less intense emotional responses than non-experts when viewing artworks (Else et al., 2015; Leder et al., 2014; Pihko et al., 2011). As noted throughout this chapter, however, the lack of contextual information presented here may play a role in emotional differences between experts and non-experts. Additional context surrounding a stimulus is known to facilitate emotional experiences (Gartus & Leder, 2014; Gerger et al., 2014; Leder & Nadal, 2014; Pelowski et al., 2017), including awe, (Shiota et al., 2007) and aesthetic appreciation (Brieber et al., 2015; Gartus & Leder, 2014; O'Doherty, 1999; Pelowski et al., 2017), and experts and non-experts alike appreciate the inclusion of additional context when evaluating art (Mullenix & Robinet, 2018). Future research in this area,

therefore, may consider whether the addition of further context – such as would be presented in an *in-situ* experiment – may facilitate or hinder awe experiences in individuals with medium-specific expertise.

In addition, it is unknown what role expertise would play in the evaluation of stained-glass window lighting conditions, such as those utilised in Experiment 2. Expertise is known to mediate the effects of some bottom-up factors, such as abstractness and complexity (Bimler, Snellock, & Paramei, 2019; Darda & Cross, 2022; Leder et al., 2012; Pihko et al., 2011; Silvia, 2013; Van Paasschen, Bacci, & Melcher, 2015; Walker, 1981) while reducing the affective impact of others, such as the tone or valence of an artwork (Brattico et al., 2016; Leder et al., 2014). How experts may differ from non-experts in their evaluation of different light variations when viewing stained-glass windows – especially with the consideration of variation category-specific differences, as shown in Chapter 4 – is unclear, and future studies should examine how expertise influences interactions with this very essential factor of stained-glass windows.

5.3.3 Feature-Specific Factors Affect Emotional Responses and Aesthetic Judgments of Stained-Glass Windows

The majority of the main effects listed in Chapters 3 and 4 highlight the significant impact of bottom-up factors when it comes to aesthetically evaluating and emotionally responding to stained-glass windows. In Chapter 3, the most notable effects reported are taken in comparison of differences in visual complexity: windows with higher visual complexity were rated with more intense awe responses, were liked more overall, and were considered more beautiful than windows with lower visual complexity. These results imply a positive linear relationship between visual complexity and aesthetic responses, including the complex experience of awe, which contradicts prior research into the role of visual complexity (e.g. Berlyne, 1970, 1971, 1974; Cox & Cox, 2002; Forsythe et al., 2011; Marin et al., 2016).

However, it should be noted that complexity was treated only as a two-level variable here, and future research may seek to explore its effects further in the context of stained-glass windows by applying it either as a multi-level factor or as a continuous variable in order to track trends between visual complexity and aesthetic appreciation.

In Chapter 4, we find similar interactions with light variation as a bottom-up factor: while general light variation conditions were not significant, differences between specific light variation categories – i.e. bird, tree, cloud, rain, lightning, firework, and the control condition – were. The most notable facet of these effects is the finding that the control condition – wherein no light variation was applied and only diffuse lighting of the window was presented – was preferred on average over all other light variation categories. As has been repeated throughout the course of this thesis, stained-glass windows are unique in their application because of their interaction with light and the manner in which diurnal changes in light and shadow throughout the day influence the viewing experience. It is possible that the types of light variations we employed were simply not the kinds which would be naturally preferred, as prior research has shown that people form preferences for specific weather and lighting conditions in a given environment (Smalley & White, 2023). However, we also suggest again the influence of context: Experiment 2 was an online study, and the external environment in which participants took the experiment was not able to be controlled for. Furthermore, the intentional decision to remove all external context from the images presented – including any obstructing objects or architectural framing – may have reduced their visual functions to behave more like other, non-changing forms of art, like paintings. Future research should explore how context facilitates appreciation of light variations in stained-glass windows and whether the addition of further information about the window's placement and

surrounding environment might increase appreciation for non-diffuse windows.

Notable as well in this experiment is the lack of differences between religiosity groups. While the choice to recruit participants who identified either as having Christian beliefs or being non-religious was intentional, there is a possibility that the choice to not specify between denominations of Christianity – particularly between Roman Catholics and Protestants – may have influenced aesthetic appreciation based on evaluations of the content of the windows. It has been demonstrated that different denominations of Christianity can formulate different judgments about styles and subjects of artworks (van Eijck, 2012), and the sample we incorporated into our experiments happened to contain several specific demonstrations of Catholic iconography. This includes depictions of saints and the Virgin Mary, which are key figures in Roman Catholic doctrine but not in Protestant doctrine. Future research, therefore, may seek to explore if effects of religiosity would be more prominent in consideration of specific denominations of Christianity rather than as a general 'Christian' population. They may also seek to examine how non-figural or secular stained-glass windows are appreciated differently by different denominations of Christianity in comparison to windows with recognizable figures in them, which can inform aesthetic psychologists as to the role of content and preconceived preferences for artistic themes in viewing religious art.

5.4 LIMITATIONS

In consideration of the impact that the findings of this paper may have on future research pursuits, it is worth noting some general limitations of the research presented. First and foremost, it should be noted that both Experiment 1 and Experiment 2 were underpowered in their samples. In Experiment 1, the original sample size of the data (n = 40) did not meet the minimum sample in order to achieve 80% power at a large effect size (*N* = 52) for an independent-samples t-test. In Experiment 2, the original sample size collected (n = 52) also did not meet the minimum sample in order to achieve 80% power at a large effect size (*N* = 66) for a one-way ANOVA test. These underpowered samples were further complicated by the loss of data in both studies due to technical errors, particularly in Experiment 1, which decreased the sample sizes further. This limitation means that not only are there certain effects which may not have been evident due to a small sample and insufficient power, but that those significant effects which were observed are not necessarily representative of associations which exist on a larger scale. Additional data may have provided a clearer distinction between different groups under consideration and may have resulted in more robust analyses for between-subjects relationships in both experiments.

The experiments presented in this paper are further limited by not taking into account the effects of context. As we have discussed previously, both in this chapter and in Chapters 3 and 4, the settings of both experiments did not allow for many contextual factors to be taken into account; as studies comparing laboratory settings and museum settings for viewing art have shown, contextual information provided by being in the presence of the artwork itself can enhance the aesthetic experience and increase responses of aesthetic liking and pleasure (e.g. Pelowski et al., 2017). In consideration of stained-glass windows specifically, one additional element may be the natural translucency and

distortion of light (Allen, 2012) which cannot be efficiently captured on a computer screen. Our procedures for Experiment 1, in which the stimuli were shown in a laboratory setting, may have reduced participants' association with the images' contextual information which would have facilitated aesthetic judgments and emotional responses. The same can also be said for Experiment 2, and to a greater extent: because the experiment was online, the environment surrounding the participants taking part in the study could not be controlled and therefore may have further altered responses to the aesthetic pleasure items. Context and its role and aesthetic perception are discussed further in the next section as it relates to future research pursuits; here, we acknowledge that the present procedures did not take context into account as an influential factor, and therefore its impact on the aesthetic judgments of stained-glass windows remains to be explored.

5.5 CONCLUDING REMARKS

In her account of the Victorian art of the spectacle and their fascination with stained-glass windows, art historian Jasmine Allen (2012) writes the following:

> 'Stained…glass intervenes between the viewer and the light source in a unique way. And we do not look through a stained-glass window, but *upon* it. Stained glass is thus more concerned with the *translucency, refraction*, and *distortion* of light than its own transparency, or with the transmission or reflection of light.' (p. 3)

It is this concept of stained-glass as an artistic medium and aesthetic experience which has driven the pursuits of the current thesis. In what is, to the best of our knowledge, the first scientific exploration into how people view, evaluate, appreciate, and respond to images of stained-glass windows, we have discussed the influences of both observer-based factors and features specific to the medium itself, including and especially light variation. The results of these investigations present a groundwork for future researchers to build from in their own explorations of how people appreciate this unique, kinesthetic artform. We have considered here how the present research fits into what is already known about how individuals perceive aesthetics and how it opens up a new road of possibilities for future aesthetic psychologists to embark upon. As the discipline of aesthetic psychology begins to grow and evolve to encompass new perspectives and observations of how we as people appreciate what is beautiful in our world, the present authors hope that the findings presented in this paper serve to emphasise the importance of stained-glass windows from a scientific perspective and bring their significance into the light.

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APPENDICES

Appendix A: Ethics Approval for this Project

F.A.O. Elizabeth Mason

Approval ID: SPREC112022-04

School of Psychology Research Ethics Committee

19th December 2022

Dear Elizabeth,

The School of Psychology Research Ethics Committee has reviewed your application entitled “To Wonder and Stand Rapt in Awe: Light Variation and the Awe Experience in Viewing Stained Glass Windows”, and I am pleased to inform you that it was approved.

Please note that you will be required to submit a completed **Project Annual Report Form** on each anniversary of this approval, until such time as the research is complete and the thesis is submitted. The form is available for download from the Ethics section of the School website.

Adverse events associated with the conduct of this research must be reported immediately to the Chair of the Ethics Committee.

Yours sincerely,

Richard Carson
Chair,
School of Psychology Research Ethics Committee

TCD Security: 01 896 1317

Any incidents such as those described below **must** be reported to the Head of School and to the Ethics Committee

SCENARIO 1: Participant becomes distressed without apparent cause. No risk of harm is evident to researcher.

The lab environment may be intimating. During testing, a participant becomes notably distressed or uncomfortable.

Response:

- End data collection.
- Ask how the participant is feeling to identify problem: e.g., *are you feeling overwhelmed/claustrophobic/uncomfortable etc?*
- Remind the participant of their right to end data collection and/or withdraw from the study at any time.
- Offer a break. Offer water. Ask if they'd like to step outside. Ask if they have any strategies (e.g., mindfulness) that help when they are feeling distressed.
- After the session has ended, inform study PI. Review study procedures to understand the source of the distress and to identify if recurrence can be prevented.

SCENARIO 2: Participant discloses a history of self-harm or current plans to self-harm

It is possible a participant will disclose information that suggests that they are at risk through their own behaviour. Here, assess the risk level and decide an appropriate response.

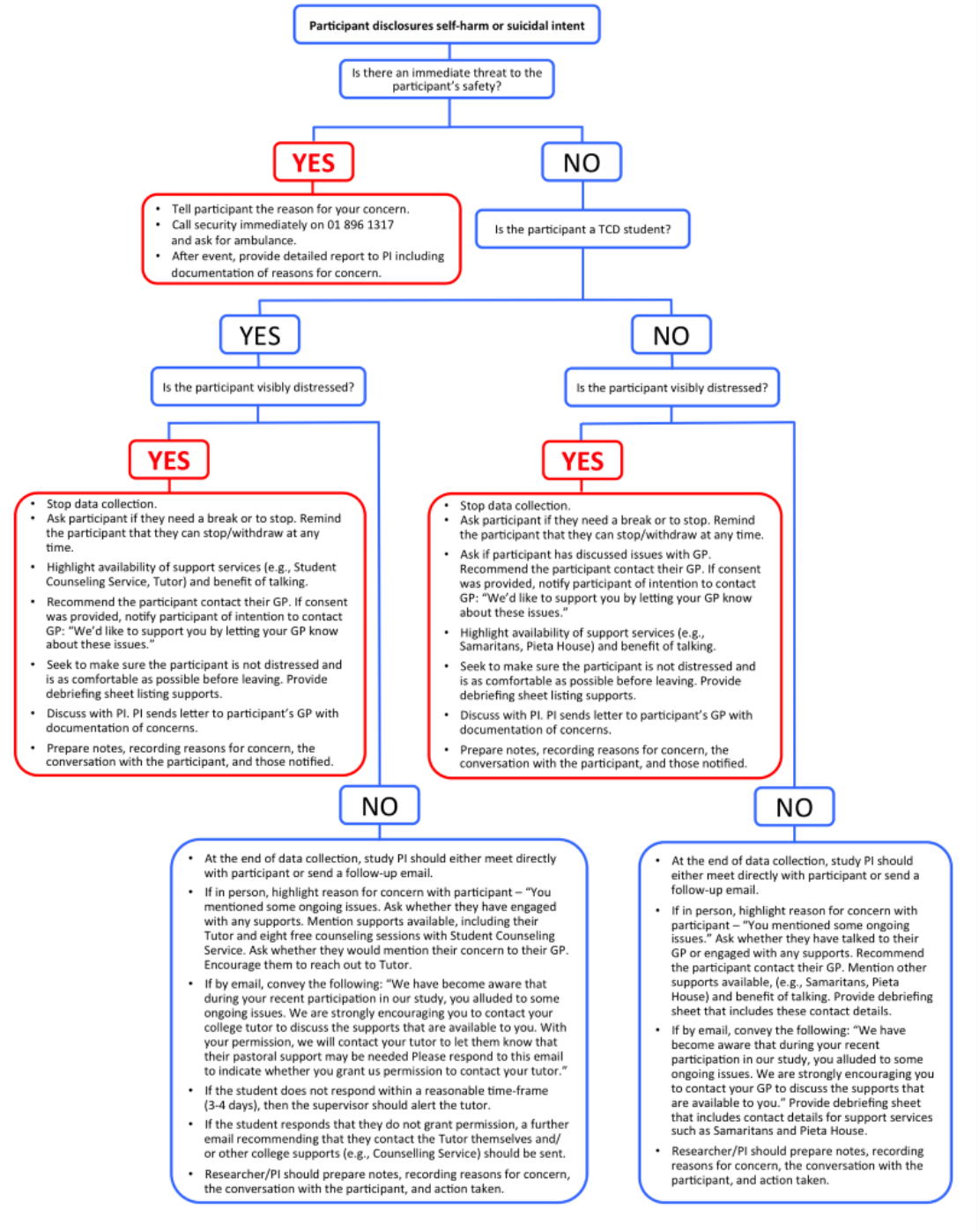
Risk assessment is informed by three pieces of evidence. Any one of these alone may be sufficient to prompt a response.

1. Excessive concern of experimenter.
- *Does the participant's behaviour, words, or actions worry you?*
- *Have they indicated (e.g., on a clinical assessment) that they are experiencing high levels of distress and/or have a suicide plan?*

2. Immediacy of risk.
- Do the participant's words or actions suggest that they are at immediate risk – e.g., suicide plan is ready.

3. Availability of support services – what is the answer to the following questions?
- *"Are you in counselling?"*
- *"Are you in contact with a mental health service?"*
- *"Does anyone else know about these feelings?"*

4. Is the participant a TCD student or someone from outside the College?



SCHOOL OF PSYCHOLOGY
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Appendix B: Supplementary Material for Chapter 2

A single linear regression determined that reported average values of CCOM (M = 5.300, SD = 1.480) and NCOM (M = 5.330, SD = 1.470) across stimuli images significantly predicted each other, $F(1,158) = 260$, $p<0.01$, with an R^2 of 0.622. This relationship is illustrated in Figure 6-1.

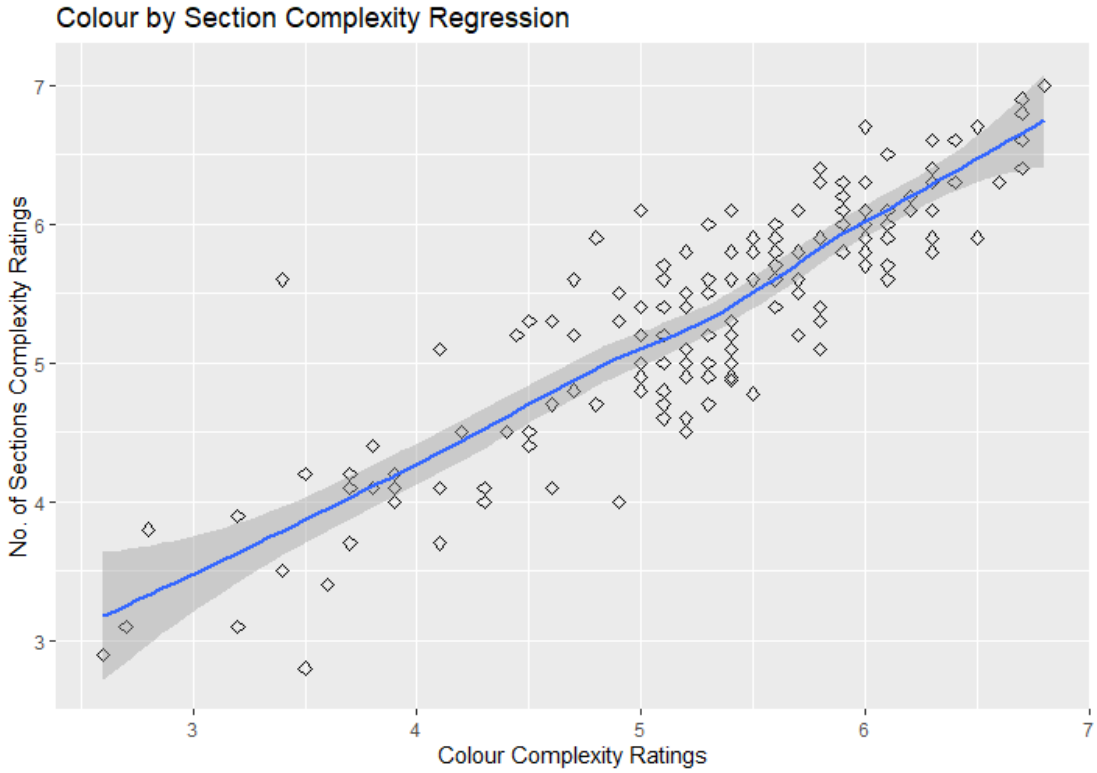

Figure 6-1: Linear relationship between CCOM and NCOM variables, relating to overall values of visual complexity. Results support previous research indicating factors of colour variability (Kocaoğlu & Olguntürk, 2018) and the number of unique items or areas in an image (Rosenholtz et al., 2007) in determining visual complexity.